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ENGINEERING NEWS.

THE PROPOSED NEW MASTER CAR-BUILDERS' STANDARDS have all been adopted, with the exception of the form of journal-box lid. The standards were described on page 99 of our issue of Aug. 3. The Fletcher lid was adopted by a vote of 370 to 107; but the specification for its dimensions lacked 52 votes of being carried. The very important standard specification for cast-iron wheels was adopted by a vote of 362 to 83; but the accompanying guarantee would have been defeated by a change of 10 votes from affirmative to negative. On the various dimensions of a standard axle for 60,000 lb. cars, the vote showed substantial unanimity, averaging only about 35 votes in opposition on the various dimensions. On length of journal, the vote was unanimous. The standard brake gear for air-brake cars also met with very general favor, the majorities in favor of its adoption averaging on the various details about 120 votes. This was a well-deserved compliment to the careful work which was done by the committee which prepared this most important standard. On draw-bars and carrier irons for the M. C. B. coupler somewhat more opposition was shown, but they were adopted by good majorities.

THE LONDON AND NORTHWESTERN STANDARD THIRD-CLASS CAR has increased in length, since 1872, from 30¼ ft to 42 ft., and the weight has increased from 10 tons to 18 tons. The seating capacity has grown from 50 passengers to 70; or while the weight has increased 80 per cent., the gain in seating capacity is only 40 per cent.

THE WESTINGHOUSE-EDISON electric light suit, which has been argued for some time past in Pittsburg, was dismissed on Oct. 5 by an opinion of Justice BRADLEY, of the U. S. Supreme Court. This suit was brought on the use of the fibrous carbon or incandescent conductor in an air-tight globe, and the point at issue was the form and substance of the conductor. The court holds that the claim of the Westinghouse interest to priority of invention in the fibrous carbon filament is not valid, as EDISON had accomplished the result before SAWYER, MANN, or WESTINGHOUSE.

ANOTHER MONSTER GAS VEIN has been tapped at Upper Sandusky, O., by a well put down by the city gas trustees. The roar with which the gas escapes can be heard over two miles. The natural flow of the well is estimated at 28,000,000 to 32,000,000 cu. ft. per day.

RAILS WELDED TOGETHER BY ELECTRICITY is the latest reported device of Prof. ELIHU THOMSON. Its effect will be of the first importance if the process be practical for preventing the jolting at passage of rail joints. The rumor further states that the welding is to be done after the rails are laid by an electric welding machine, with joints left at 100-ft. intervals to provide for expansion.

THE MANCHESTER SHIP CANAL is advancing so fast that there seems every prospect of the contractor, Mr. T. A. WALKER, being able to claim the honorarium agreed on of $500 for each day that the canal may be in a finished state before Jan. 1, 1892. No less than 200 miles of railway lines are laid down or near its banks; 150 locomotives are at work to remove the soil, which is being dug out by some 15,000 human navvies and by 80 steam ones. One of these latter fills 650 wagons daily, holding 4 cu. yds. each. The value of the plant alone is $3,500,000. In addition to 15,000 men and boys, there are 183 pumping engines, 4 pile drivers, 80 steam navvies, 5,000 wagons, 150 locomotives, 116 steam cranes, and 205 horses.

THE REPORTED NICARAGUA CANAL TROUBLE with the Government of that country is said by Dr. HORATIO GUZMAN, Minister to the United States from Nicaragua, to be a report inspired by parties who do not wish to see the canal built by the present company. There are some differences of opinion on minor details of purely a business character, but wholly unimportant. Dr. GUZMAN expects to see the work of digging commenced in a very short time a report reaches us via San Francisco, as we go to press, that the whole difficulty has been arranged by the American Minister.

A MICHIGAN CANAL is being talked of. It would connect Grand Rapids with Holland and Lake Michigan. The estimated cost is $2,000,000.

AN ARTIFICIAL FRESHET has been made in the West Branch of the Susquehanna River to recover the logs lost and stranded between Williamsport and Sunbury. The dam at the first-named city was raised about 3½ ft. by a temporary structure, which backed the water up 11 miles. This temporary "splash" dam was suddenly broken on Sept. 30, and as a result it is said that 1,000,000, ft. of timber has been safely gathered into the Muncy slips. Another "splash dam" is to be built.

THE NEW CROTON AQUEDUCT CLAIMS, for extra work of Rogers, Shanley & Co., assignees of John Brunton & Co., on Sections 13 and 14, for $241,286.30, still remain unexamined by the controller. The claims were filed on July 20, and the delay is now explained by the statement that the special counsel appointed to attend to it was still out of town.

THE MOST SERIOUS RAILWAY ACCIDENT of the week was a derailment on the Rome & Decatur Railroad, near Rome, Ga., on Oct. 5. A train of empty ore cars was being hauled by a freight engine, which was running tender first. The tender left the rails on a straight piece of track, and the engine followed, both going down the bank, while 5 cars were wrecked. There were 2 men killed and 2 injured.——A passenger train was derailed near Cheyenne, Wyo., on Oct. 3, and 7 persons were injured; the track is said to have been in bad condition.——Two collisions have occurred between freight trains and wildcat engines, one on the Columbus & Western road, Oct. 4, and the other on the Richmond & Petersburg road, Oct. 8; the latter was due to misunderstanding of orders on the part of the engineer of the wildcat.——A collision between two coal trains occurred Oct. 6, near Le Roy, N. Y., on the Buffalo, Rochester & Pittsburg road, owing to one of the engine-drivers acting upon orders issued for the previous day. The trains met on a culvert, which gave way. No one was injured.

BRIDGE ACCIDENTS are reported as follows: A highway bridge at the lime kiln near Danbury, Conn., gave way under a team Sept. 19; 1 man was killed and 4 others were injured.——The iron county bridge over the Elm Fork of the Trinity River, Texas, 7 miles southwest of Pilot Point, was wrecked on Sept. 23, owing to the recent floods having undermined one of the piers. The bridge was built in 1882, at a cost of $8,000.——A bridge over a small stream near Janesville, Ind., gave way Oct. 3 under a traction engine and threshing machine; five men went down, 2 were killed and 3 seriously injured. There are a great many highway bridges, especially over small streams which are far too weak to carry such loads.

A SERIOUS ACCIDENT occurred Oct. 4 at the lift bridge over the canal at West Ave., Rochester, N. Y. A street car was passing over, when one end of the heavy troughs filled with pig iron, forming the counterweights of the bridge, fell from its support, and 1,500 lbs. of pig iron crashed through the top of the street car. Two persons were fatally injured and three others seriously injured. One of the wire cables is said to have been worn out, which would seem to show a lack of proper inspection.

THE WEATHER has been quite cold on the Atlantic coast, and snow has fallen in Pennsylvania. A heavy storm and cyclone in the Gulf of Mexico on Sept. 21 caused much damage along the coast of the State of Campeachy, and many shipwrecks occurred.——Earthquake shocks were felt at Wawona and Yosemite, Cal. on Sept. 29.

THE NEW YORK STATE RAILROAD COMMISSION on Oct. 7, on the application of the Central New England & Western Railroad Co. for an extension of time to comply with the car-heating law relative to heating its passenger cars by other means than a stove or furnace, decided that, inasmuch as the railroad has shown that it has the material at hand with which to equip its cars with steam-heating apparatus, it may have until the 1st of November next in which to do the work. The commission also extended the time for the Pullman Palace Car Company to complete the equipment of its cars with steam-heating apparatus until Nov. 1 on the representation that it had but 18 cars running in this State which were not yet so equipped.

ENGLISH AND SCOTCH ENGINE RUNNERS, according to a letter in the Philadelphia *Press*, receive from $1.82 to $1.50 for 12 hours' labor, with 20 cts. per hour over time. There are two classes of runners, and a second-class man must run an engine two years before he can be promoted to first-class. If he has ill luck, or has violated any rule, he is fined a shilling a day for a specified time instead of being suspended or discharged. A fireman must fire an engine six years before he can stand examination for promotion to second-class engine runner. As a class, they simply earn money enough to live upon. French engine runners receive from $2.00 to $2.20 for 10 hours' work, with 25 cts. per hour for over time. In Germany and Belgium $1.50 is about the pay of engine runners.

MAYOR ROBERT MORAN, of SEATTLE, W. T., in his annual message takes a broad and hopeful view of the city's future, notwithstanding the serious conflagration of June 6. He advocates the establishment of a complete system of water-works, a system of sewerage, and a system of street lighting, all to be owned and operated by the city. For fire protection, a paid fire department to take the place of the volunteer organizations has been decided upon, and new fire apparatus and a Gamewell fire alarm system have been ordered. The mayor further recommends that the streets be graded and paved, that sufficient public buildings for the use of city departments be erected, and that the city take advantage of the clause in the recently adopted constitution by which the municipality is given ownership and control of its own harbor front.

These various improvements will necessitate an issue of city bonds to the amount probably of over $1,500,000.

NEW WATER-WORKS of great local importance are at present being constructed in various parts of Scotland. The most important of these is a reservoir which is being erected near Glasgow, and is meant to meet the increased requirements of the inhabitants of that city. This reservoir will cover about 70 acres, and will also include a farm which had to be purchased by the Corporation at a cost of $110,000 for 136 acres. The depth will be 90 ft. in some places, and at the outfall culvert 60 ft. It will have a capacity of 700,000,000 galls., or 14 days'

supply at the rate mentioned—in all 25 days. The new tunnel will pass daily 70,000,000 galls., as against 42,000,000 by the old one. The outlay of the original works was about $7,500,000 up to 1860, and the time occupied was 3½ years.

IQUIQUE, PERU, proposes to expend $500,000 in town drainage, according to the Panama *Star and Herald*. It is said that there are 5,000 houses in that city which will pay from $12 to $50 each, and the Government has promised to advance $100,000 towards the work.

A LARGE DRAINAGE WHEEL, 54 ft. in diameter has, just been completed by the Dickson Mfg. Co., of Scranton, Pa., for the Calumet & Hecla Copper Mining Co. The wheel will lift tailings and discharge them into Lake Superior. The wheel carries on its outer face 432 epicycloidal teeth of 4.71 ins. pitch and 18 ins. face, machine dressed. This pinion is made up of 18 segments. It will run at a maximum speed of 600 ft. per minute, circumferential velocity. The wheel carries 448 steel buckets, which lift the sand and water, and discharge them into launders along which they flow to the lake. The maximum capacity will be 3,000,000 galls. of water and 2,000 tons of sand in 24 hours. The shaft on which the wheel turns is 30 ins. in diameter at the wheel-fit and 22 ins. in diameter at the journals. The machine was designed by Mr. E. D. LEAVITT, of Cambridgeport, Mass. Wheels working in a similiar manner have been in use by the Calumet & Hecla Co. for some years.

TWO WATER-WORKS ACTS have been passed by the New Jersey Legislature this year, and approved by the Governor.

Chapter XLV. of the Statutes amends a previous act in such a manner as to make it the duty of boards having control of the water supply of cities to pay to the Commissioners of the Sinking Fund so much of the revenues from the water-works as is necessary to pay the interest on the water bonds. The act also provides that all the yearly revenue above current expenses and the payment of temporary loans shall be used solely to pay the funded debt and interest thereon, so long as such a debt exists.

Chapter XLVII. authorizes water companies with a capital stock of less than $20,000 to increase the same to an amount not exceeding $50,000, on condition that three fourths of the stockholders consent to such an increase, and that a certificate of the action is filed with the Secretary of State.

ALL RAIL TO EUROPE, via Alaska and Behring Strait, is again being broached, and the first step is being taken in the direction of promoting a railway line from Spokane Falls, Washington, to Alaska. The estimated cost of the 3,000 miles required is $130,000,000. As to revenue, this is expected to come from the agricultural and grazing lands of the famous Kootenai Valley and the mines along the Columbia River and in other mining sections. The climate, west of the Coast Range of mountains, is claimed to be little more severe than that of New York clear to Sitka. It is a scheme of magnificent but somewhat airy proportions.

A RUSSIAN RAILWAY TO MESHED is said to be a thing of the near future. This means increased Russian influence in Persia and a railway extension of 150 miles, from Askabad on the Trans-Caspian route, between the Caspian Sea and Merv. It is less than two years ago since the Shah absolutely refused permission to Russia to even establish a consulate in Merv.

THE REPUBLIC OF SAN MARINO, in Italy, the oldest and smallest of existing republics, has an exhibit at Paris. San Marino, as an independent government, dates from the third century of our era and it covers just 23 sq. miles. It was one of the first "governments" to officially notify the directors of the Paris Exposition of its intention to participate. The exhibitors number 50 out of its 8,000 population.

THE BARONESS BURDETT-COUTTS, through the Secretary of the Institution of Civil Engineers, of London, requests the photographs of the American engineers who attended the garden party at Holly Lodge in June last. The photographs should be sent to 1 Stratton St., Piccadilly.

The Government Timber Dry Dock, St. Johns, Newfoundland.*

The dry dock which is the subject of this paper is situated at the Riverhead or western end of the harbor of St. Johns. It is built of wood and concrete. The form is illustrated on the plate herewith, and the following are the principal dimensions:

Length upon top from inside of head to gate when at outer sill	600	ft.	
Length upon the line of keel blocking	558	"	
Width upon top at head	78	"	6 in.
" " body	132	"	6 "
" " abutments	84	"	9 "
Bottom width from inner end of abutment to angles near head	49	"	10 "
Bottom width at abutments	52	"	9 "
Depth of water over gate sill (H. W. spring tides)	25	"	

The floor is founded on a bed of Portland cement concrete, laid on exceedingly hard cemented gravel (glacial drift) immediately overlying the bed rock. Bedded in the concrete, and held down by frequent anchor straps of 2½ in. x ⅝ in. iron, is a system of longitudinal pitch pine timbers 12 ins. square. Immediately under the keel track, four of these are laid close together, each anchored to the concrete and all bound together by through bolts. Two on each side of the keel track timbers are one foot apart, and the remainder of the longitudinals from this to the edge of the floor are set with 3-ft. spaces. The anchor straps are bolted alternately to opposite sides of the timbers, and are held in the concrete by a single right-angle bend.

Cross floor timbers of pitch pine 14 in. x 16 in., and 4 ft. from center to center, are laid on and securely fastened to the longitudinals. Their ends are boxed down to receive a stringer piece 12 in. x 14 in., which runs around the sides and head, and receives part of the thrust from the main braces.

The concrete extends beyond the floors, and is carried 3 ft. up the sides and head behind the altars. Within the floor area it fills the spaces between cross floor timbers at their ends, and slopes thence gradually to shallow drains formed between the longitudinals, one on each side of the keel track. The entire lower system of floor timbers is completely embedded in and covered by concrete.

The working floor is of 3-in. plank, spiked to the cross timbers, with ample opening left at the joints.

In order to lessen the possibility of water courses, the longitudinal timbers are omitted in the abutment and under the gate platform and apron; but here the concrete, instead of being as at the head 2½ ft. average depth, is 6 ft. deep, with anchor straps for the cross floor timbers extending to the bottom.

No indications of springs were observed during construction. It was thought best, however, in view of possible developments of either spring water or under leakage, to insert in the concrete 2-in. vertical iron tubes, 20 ft. apart, alternating on opposite sides of the keel track throughout the length of the dock. The lower ends, extending into the gravel below the concrete, were left open, and the upper ends, protruding above the concrete, were fitted with valves (light dead-weights) opening upwards. There has been no flow from these tubes.

A line of sheet piling surrounds the entire structure at a distance of 26 ft. from the coping. The sides of the dock are supported by transverse frames 4 ft. apart from center to center, extending from the floor to the line of sheet piling, and made up as follows: A heavy pitch pine main brace or rafter, abutting at its lower end on the cross floor timber and stringer already described, and at its upper end on the coping; a cap of 12-in. square pitch pine, running horizontally from coping to sheet piling; brace and cap resting on 12-in. spruce piles 5 ft. apart, all three parts of the system being bound together by a diagonal tie of pitch pine, firmly bolted to them, and acting, to use another roof term, like an ordinary collar beam.

These transverse frames are connected on top by the coping, which is built up of three heavy pieces of pitch pine, and are further stiffened laterally by the altars. The altars are of pitch pine. Two are sawn from a stick 11 ins. x 14 ins. by ripping obliquely, not from corner to corner, but cutting each 14-in. side 3 ins. back from the corner. These are bolted with an oblique face resting on the main braces, an 11-in. side uppermost and horizontal, and a 3-in. side looking towards the coping, and covering by that much the next altar above. A series of continuous steps, ascending from floor to coping, with 8 ins. rise and 11 ins. tread, is thus formed around the entire body and head of the dock, admitting of convenient access at any point.

The entrance works differ somewhat in detail of construction from the body. Six lines of transverse sheet piling on each side run from the floors to the main outer line before referred to, one at the end of the apron, two at each sill, and one at the inner end of the inner abutment. The concrete foundation is carried 5 ft., beyond the floors, and the sides or walls are backed by concrete 5 ft. thick at the bottom and 2 ft. thick at coping. The cross floor timbers and main braces are covered by two thicknesses of 6-in. timber breaking joint. Each course is thoroughly caulked with dry pine wedges.

The transverse floor timbers in the inner abutment are 10 ins. higher than the corresponding body floor timbers. The rise from the main floor is formed by six large oak timbers, rabbetted and bolted together, and backed up by heavy oak knees, running back over and framed into the main floor timbers.

There are two positions for the gate 20 ft. apart. At each sill four heavy pieces of oak, rabbetted and securely fastened together, form a step or offset, that runs across the floor and up the sides, and receives the weight and thrust of the gate when in position. The top courses of 6-in. timber are rabbetted into and are flush with the sill timber. There are no grooves, and the chances of troublesome obstructions are consequently much lessened. The offsets are fitted with stout rubber gaskets, against which the gate bears and forms a water-tight joint.

The apron is constructed on a concrete foundation in similar manner to the floors of the gate platforms, the timber being covered with an extra layer or facing of concrete. The apron proper extends 21 ft. beyond the outer sill, with a concrete toe carried 13 ft. further.

Sheet piles are of spruce fitted with dry pine tongues or keys. Bearing piles are of the same timber. All are driven to the hard gravel on which the concrete foundations of the floors rest, so that the whole structure has a perfectly uniform bearing.

The excavation of the dock basin was made after most of the piles had been driven. The material excavated was alluvium, having but a small proportion of gravel, and was found to be impervious to water; hence no more was disturbed than was necessary for the setting of main braces and ties. As the altars were put on, all existing spaces were filled with suitable material taken from the excavation, and thoroughly rammed. Very slight indications of leakage appeared at several points in the plane, dividing the more recent from the glacial drift. This was doubtless caused by the same plane having been cut in dredging a wet slip on the south side of the dock.

The area around the dock was filled with earth carted from the neighboring hills, and was graded level with the top of the coping timber. Cross-caps and sheet-piles are thus covered by about 2 ft. of ground.

The cofferdam was formed by driving three parallel rows of sheet piling about 5 ft. apart, each row being reinforced by round piles and braces. The intervening spaces were filled with earth. In plan its form was three sides of a rectangle, the two parallel sides being under the piers at each side of the dock entrance, and the third connecting them just outside the toe of the apron.

The dock is fitted with sliding bilge blocks, 28 on each side, operated from the coping by endless chains. Keel blocks are placed on each cross-floor timber. They are thus 4 ft. apart from center to center.

Materials are sent to the working floor by means of six slides conveniently situated, three on each side of the dock.

The gate is a floating iron caisson. It is provided with a steam capstan, a 10-in. direct acting centrifugal ballast pump, and a boiler. The capstan stands on the upper or flush deck. The engines that operate it, and all the other fittings, are on a lower deck.

Eight pipes, or filling culverts, 22-in. diameter, that pass athwart-ship through the gate, afford a means of filling the dock. They are fitted with valves controlled by hand-wheels on the lower deck. The gate is moved into and out of position by the

*A Paper by H. C. BURCHELL, M. Can. Soc. C. E., before the Canadian Society of Civil Engineers.

steam capstan and suitable warps. Raising and lowering are effected by the ballast pump and inlet valves.

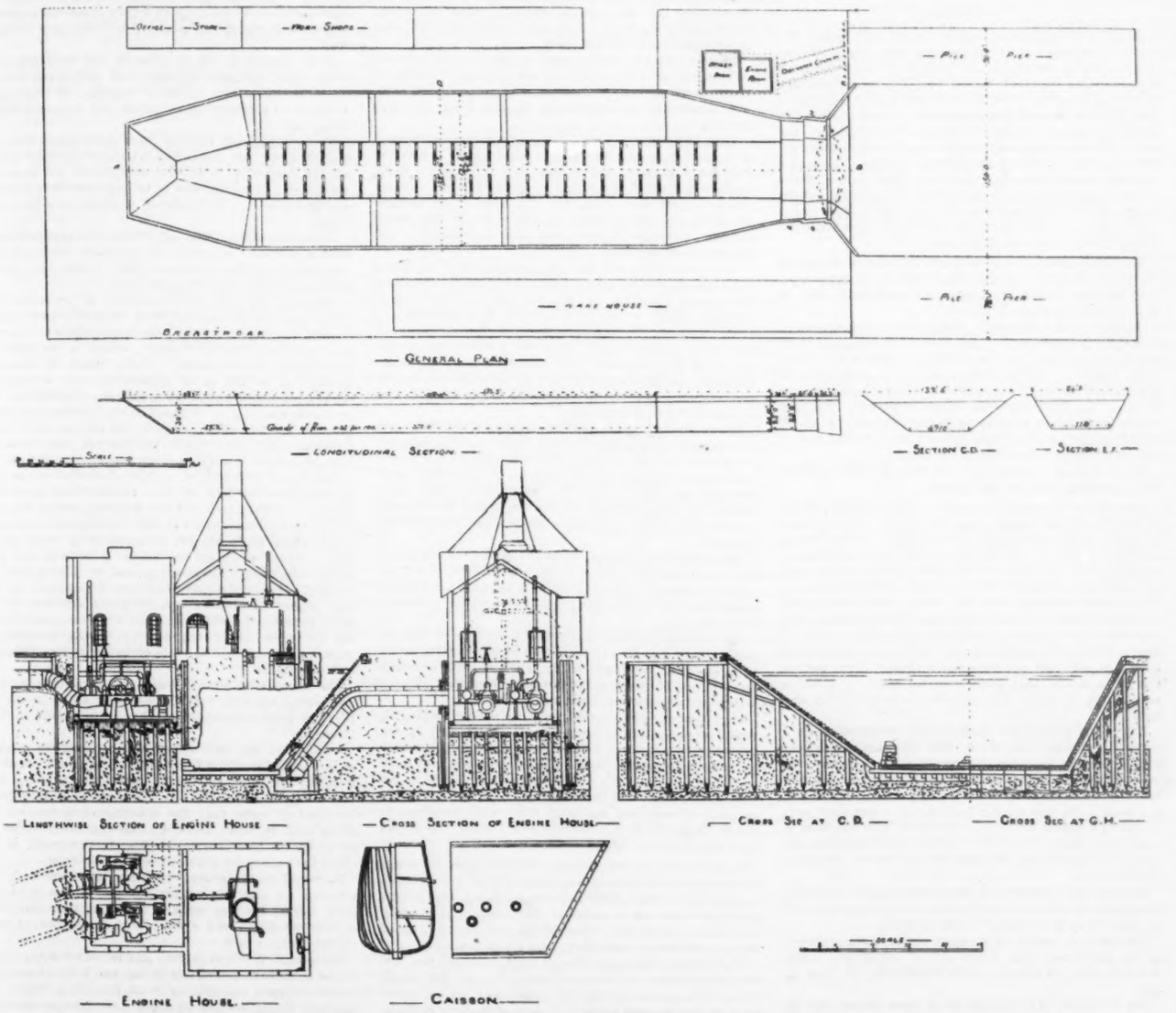
The pumping installation is placed in a brick building a little to the back of the abutment on the north side. The pumps and engines were made by W. H. Allen & Co., of London, England. There are two 30-in. centrifugal pumps, each driven by an independent single engine. The discs are 5 ft. 6 in. in diameter, with curved arms similar to the Appold.

and brought up level with the caps. A double floor of caulked 3-in. spruce was then laid, and another thickness of concrete placed on it. The pumps and engines were bedded on this foundation in concrete faced with brick. The walls of the engine house start from the same platform, the space between walls and sheet piling being filled to the surface with concrete.

There are two boilers of the marine type built of Siemens-Martin steel. They are 12 ft. 9 ins. dia-

On the south side of the dock is a wooden freight shed, 400 ft. x 40 ft., conveniently situated for a storage of cargo, either from ships in the channel dredged directly alongside or from ships in the dock.

On the opposite or north side a brick building 400 ft. x 35 ft. affords ample space for convenient office accommodation, stores, and workshops. The shops are furnished with electric light plant, punch, shears, rolls, and other machinery suitable for re-


— General Plan —
— Longitudinal Section —
— Section C.D. —
— Section E.F. —
— Lengthwise Section of Engine House —
— Cross Section of Engine House —
— Cross Sec at C.D. —
— Cross Sec. at G.H. —
— Engine House. —
— Caisson. —

Timber Dry Dock for Colonial Government, St. Johns, N. B.—J. E. Simpson & Co., *Engineers and Contractors.*

The suction expands from 30 ins. to 36 ins., the size of the wrought-iron suction pipe. The discharge expands from 30 ins. to 48 ins., at which size it delivers into a brick culvert 14 ft. 6 ins. wide, 5 ft. 8 ins. deep, and 60 ft. long. The suction is divided into two passages at the periphery of the pump, and water is drawn into the disc chamber from both sides at the center. Each pump is fitted with a steam ejector for priming. The engines are single, horizontal, variable cut-off, directly connected to the pump shafts, having cylinders of 21 ins. diameter and 22-ins. stroke.

The drainage and leakage are removed by a 10-in. Heald & Cisco centrifugal, driven by a pair of vertical engines directly connected.

The engine pit is enclosed by sheet piling. For a foundation, round piles were driven 3½ ft. apart, all soft material was excavated to a depth of 2 ft. below floor level, and a quantity of loose stone thrown in. The piles were capped, and concrete laid n the loose stone was rammed round them

meter and 11 ft. 6 ins. long. Each has three furnaces 3 ft. inside diameter, 8 ft. 3 ins. long, each furnace opening into a separate combustion chamber.

The contract stipulated that there should be pumping capacity sufficient to empty the dock, when occupied by a 2,000-ton ship, in two hours and a half. At an official trial, under direction of the writer, the dock was emptied without a ship in it in 2 h. 20 min. At every 6 ins. fall of the water, observations were taken of the time, steam pressure in boilers, and speed of engines. The speed of the engines, though slightly increasing, was comparatively uniform. It so happened also that the depth of water was reduced at a uniform rate, that is to say, very nearly the same time elapsed between the observations, from which it will appear that the slip resulting from the increased depth of suction varies approximately as the contents of a layer or stratum of a given depth at varying depths in the dock.

pairs of wood and iron ships, and a stationary engine giving the necessary motive power.

Among the most prominent features in this dock are the entire absence on the working floor of discomfort or inconvenience from drainage; the abundance of light and ventilation for workmen, resulting from the great top width; the readiness with which shores may be adjusted, owing to the small and numerous altars; and the facilities for expeditious construction.

The materials used were the very best of their respective kinds, and their workmanship most thorough throughout.

The only casualty that occurred during construction was a slight movement of the material on the south side of the entrance works, before the frames or concrete were put in. It was promptly stopped by a system of struts to the opposite side, and gave no further trouble.

The work of construction was commenced on May 28, 1883, and was suspended for four montsh

during the winter of 1883-84. On Dec. 10, 1884, the dock was formerly opened, and H. M. S. "Tenedos" was successfully docked.

[This dock is substantially identical with the Brooklyn (Erie Docks) and Newport News Docks, and with those lately built for U. S. Government at the Brooklyn and Norfolk Navy Yards, as noticed in our issue of Sept. 21, the contractors for all of them being J. E. Simpson & Co., of New York. The following is the discussion on the paper.—ED. ENG. NEWS.]

DISCUSSION.

MR. F. COLLINGWOOD.—For nearly two years the writer has acted as company's engineer for a similar work, built by Messrs. J. E. Simpson & Co., from their own plans, at Newport News, Va. The two docks are so nearly identical in dimensions and structural details that in most respects the description of one is the same as of the other. While, in general, the floors are the same, the character of the site at Newport News required piles to be used throughout, to which the longitudinal timbers were drift-bolted. The James River at that point is about 5 miles wide. The shores consist mostly of fine sand and loam, so that the bottom slopes very gradually, and 25 ft. depth was not reached until about 1,600 ft. from the shore line.

The plan adopted was to build an embankment 315 ft. wide at grade, cutting down the bluff behind for the purpose, and to continue the same each side of the dock nearly to the entrance.

On the south, a timber bulkhead, 200 ft. long, served to protect the outer end of the tank and the pump and engine house, and on the north a similar one, 100 ft. long, was built. Beyond these, piers 250 ft. long, built on piles were extended on each side of the entrance, the heads of the piers reaching to about 1,100 ft. from the shore line, and to a depth of 9 ft. of water at M. H. W. Sheet piling was driven around the exterior row of piling, exactly as described in the paper.

The cofferdam consisted of four rows of sheeting filled with material from the excavation.

The bottom consisted of a soft surface deposit, below which, to the full depth excavated, there was a kind of marl, made up of great quantities of shells, mixed with sand, etc., from the shores, the fine material resulting from the wear of the shells giving it a greyish appearance. It would stand up vertically under water, and was exceedingly hard to dredge, but after being disturbed, made a thin, sticky mud. The cofferdam was not closed until the pit had been dredged to about its depth, and on pumping out the water there were from 1 to 4 ft. of mud covering the bottom. There can be but little doubt that such material may, by suitable appliances, be most economically excavated "by the day."

The winds from the northwest and southwest have a reach of at least ten miles, and the resulting waves caused serious breaches in the light earth banks, for which the specifications and plans (for which the speaker was not responsible) made no provision. The north side has been protected by the building of a ship-yard protected by suitable cribbing. The south side has been in great part protected by the travel of the sand along the shore, which has filled the angle so as to break the force of the waves.

The space 50 ft. above and below the piers and between them, and for 400 ft. in width, and to deep water in front of the piers, is to be dredged to 25 ft. depth.

The piles are mostly of Virginia pine. Those exposed to the attacks of the teredo are of creosoted North Carolina pine, and those at the bulkheads, etc., are of oak.

The teredo is very destructive in these waters, and in one season would destroy the strength of a ten-inch pile. Some of the sheeting 5 ins. thick in an exposed place was entirely eaten off in one season. The creosoting, which was altogether at the discretion of the contractors, was done at Wilmington, N. C., the *wood* creosote being used; and the result, as a test of this material on a large scale, may be looked for with interest.

The centrifugal pumps for emptying the dock were carefully designed and constructed by the Southwark Iron Works, at Philadelphia. The contract requires them to empty the dock with a 400-ton vessel on the blocks in 2½ hours. A preliminary trial, without a vessel, showed that they *can* do it in about 1½ hours. The writer regrets that he cannot at present give a description of the pumps.

The dock will be publicly opened, probably on the 10th of April. It should be stated that it is remarkably dry, almost too much so for the good of the timber.

The ship-yard has been started on a basis suited to present needs, and is to be enlarged as circumstances may require. With the many advantages of location, the whole enterprise bids fair to be a profitable one from the start.

MR. PRINDLE.—Mr. BURCHELL's interesting paper is so largely descriptive that there are some features of much interest which suggest themselves as worthy of further remark in connection with this important public work.

First, as to the design itself, with respect to the peculiar form of construction both in outline and section.

The great width on coping level, as compared with the width of floor, gives very considerable inclination to the inner face of side and head walls, and presents striking advantages in the way of furnishing light and air at the floor level of the dock.

This inclination to the vertical of the altar system, due to the great difference in width between the floor and coping levels, permits the use of low, narrow altars having the rise and tread of the steps of an ordinary staircase, and thus furnishes unequalled facilities for ingress and egress of workmen, and for reaching the floor from any point of the coping. These important points of accessibility, light, and ventilation are thus secured in a remarkable degree.

Minor advantages with respect to superior facilities for economical shoring, supply of materials, and access to the bottoms of vessels under repairs, etc., are not without value, and are incidental to this form of cross section.

True, the water prism is thus considerably increased, and more pumping of water is required to empty the dock than is called for in the case of masonry docks constructed with few altars of great rise and nearly vertical inner face walls, but the greater advantages of light, air, and accessibility far outweigh the small amount of additional coal and time consumed in the operations of docking.

It is to be observed that the greater width of docks constructed on this general plan very largely increases the area of foundations required, and also the cube of masonry which would be necessary if constructed of such material. The consideration of this plan would, therefore, at the outset, raise the question as to the nature of the materials to be employed in its construction, and render some substitute for masonry a commercial necessity, in order to reduce the cost of construction and make the plan feasible.

The slope of the altar face walls, being about the angle of repose of earth embankments, would at once suggest the absence of any necessity for great weight or strength in the way of retaining walls to resist the thrust of earth pressure, and the absence of such retaining walls obviates in turn the necessity for the heavy and more costly foundations for the side walls, which would otherwise be required.

The selection of timber, instead of granite or other masonry, would appear to have been a sensible, if not indeed a necessary, choice, in order to produce a structure combining all the advantages of the design at a reasonable cost.

The volume of masonry required for a dock of this design, with its greatly extended base of foundation, would necessarily be large and costly, even though concrete be employed for backing, and dressed stone used only for altars, entrance facing, floor, and coping.

That timber construction, such as is here employed, would prove of sufficient strength is attested by the numerous examples of similar docks in the States, which have been for many years in successful use, and have repeatedly received the largest steamships afloat with entire safety, even without discharging cargo; and as no mention of weakness has been made with reference to the St. Johns dock, it is presumed that none has as yet been manifested in this particular case.

So great has been the success attending these dry docks in the States, and such is the confidence of the Government in their entire efficiency and economy, that no less than three are now in course of construction at as many navy yards, Brooklyn, Philadelphia, and Norfolk, all of this general design, and 500 ft. long on coping level.

In addition to these, another of 600 ft. in length has just been completed at Newport News, Va., on the James River, thus now swelling the number of timber docks built on the Atlantic coast to 14, and, singularly enough, all designed and built by the same engineers and contractors, whose name the system bears in the States.

At first thought, the use of timber would seem unsuitable for such purposes on the score of durability, and apprehensions of this character would naturally arise in the minds of engineers (from which the writer himself was not exempt when he first entered upon the study of timber dry docks) in considering such a construction. Experience, however, is a safe guide in this direction, and so far the question of decay of timber dry docks has not been found to be so serious as at first imagined. It has been found that the timber most exposed to decay constitutes but a comparatively small fraction of the whole structure, and that the upper works may be allowed to greatly deteriorate without affecting the integrity of the dock itself.

Those portions which most readily decay are, fortunately, those which are most easily and cheaply replaced, and do not at all affect the foundations, which may justly be considered as substantially imperishable.

In the new timber docks just referred to, precautions have been taken to protect the coping, upper altars, and the entrance works from decay and sea worms by means of creosoting.

Should all the timber in such structures, which is not constantly wet, be thus treated, it would seem evident that the question as to the life of timber dry docks in respect to decay, as determined by actual experience, can only be answered by future generations.

The floating gate or caisson, for closing the dock, has doubtless its most prominent feature in the sloping of stems or straight overhanging ends, whereby but little handling of water ballast is required to operate it, as but little rise is necessary to lift the gate from its seat at the sill and abutments, the latter here superseding the "grooves" of the older type of masonry docks.

The employment of timber in the construction of the entrance works here again favors the system, as it is desirable to spread the face of the entrance walls to give greater width on water line, as well as to reduce the earth pressure in rear, which would otherwise demand a considerable weight of masonry to resist as a retaining wall.

With respect to the location of the St. Johns dock, many disadvantages appear to be connected with its great distance from a base of supplies, as well inconvenience of access by reason of ice and fogs on a forbidding coast.

The country and vicinity itself contributed but little else than ordinary labor, and a meagre quota of materials for construction, so that, practically, all materials, machinery, and plant had to be imported from a considerable distance, in all sorts of weather, on a dangerous coast.

A consideration of the difficulties encountered, due to such a location, only serves to emphasize the facts as to the remarkably short time actually required for the execution of a work of this magnitude.

Begun in May, 1883, and completed in December, 1884, with four months suspension of work during the intervening winter, the actual time consumed was less than fourteen and one-half months, which is regarded as a noteworthy achievement. While much is doubtless justly due to the large experience and well-known energy of the contracting engineers themselves, the principal reason is to be found in the specially favorable constructive features peculiar to the design itself, which furnishes such exceptional facilities for rapid construction, as compared with masonry docks of usual type.

Contrasted with the yet unfinished United States Government graving dock at Mare Island Navy Yard, California, of granite and concrete masonry, which has been more than a dozen years under construction, at a cost approaching $3,000,000, the comparison is very significant. True, work on the latter structure has been much interrupted and delayed, and its cost greatly increased, through repeated failures of Congress to furnish money in regular and adequate amounts as the work progressed; but the climate there is most favorable for prosecuting engineering works, particularly masonry constructions, without interruption throughout the year.

The three new timber docks, before referred to as now under construction, will probably all be in use before the final completion of this granite dock at Mare Island.

Some years ago the writer had occasion to remark, after careful study of this system of dry dock construction, that in his judgment the last stone graving dock had been projected in this country; and now he is gratified to note that the old-time conservatism has given way to more modern ideas and progress in the adoption of this system by the Government, in the official advocacy of which he was the pioneer.

It would be interesting to learn what has been the effect of ice and the winter climate on the St. Johns dock during the five winters following its completion, as also upon the new granite dock at Quebec, of more recent construction.

The granite docks at Boston and Brooklyn Navy Yards began to yield to the effects of ice and frost after a few years exposure, and notably so at Brooklyn, where the masonry finally became so much destroyed as to render the dock inoperative, and necessitated the reconstruction of the entrance works, relaying of the stairways, timber slides, etc.

Mr. BOSWELL.—Mr. BURCHELL, in his very interesting description of the wooden dry dock at St. Johns, Newfoundland, claims for it certain advantages, due principally to the character of the altars, and the correspondingly great width of the dock at coping level; but the advantages claimed appear to the writer to be doubtful ones, for the following reasons.

The change in ocean-going vessels, from the wooden sailing vessel to the iron steamship, has caused a corresponding change in the character of the repairs generally required to be executed in a dry dock. The materials necessary for the repairs to wooden vessels consisted essentially of square timber, planks, and knees; and these could be readily slid down the timber slides to the bottom of the dock, where they are fitted and placed in position. This was before the days of electric and lucigen lights, and it was consequently advantageous to provide for sunlight by increasing the coping width. With steamships the case is however different, the materials required for repairs consisting, for the most part, of heavy masses of iron, plates, and parts of machinery. The fitting and preparing of the material is completed before it is sent down to the ship, the piece having merely to be put in place on arrival. In the case of

plate, the riveting necessary for securing it in position has partially to be done from the inside of the vessel, and would require artificial light in any case. Again, these heavy pieces of iron are more readily handled by steam crane than in any other manner. A steam crane traveling along the coping of the dock can deposit the pieces of machinery, plates, etc., just where required. To avoid an excessive length of boom in the crane, the more nearly vertical the sides of the dock are the better, while with fewer altars and more nearly vertical sides to the dock, the shores also become shorter, which is an undoubted advantage. Some of the older stone docks were constructed with a cross-section very similar to the wooden dock at St. Johns, but in the more recent ones, the number of altars has been diminished, so as to reduce the width at the coping.

A dry floor is placed by Mr. BURCHELL among the prominent features of the St. Johns dock, but this should be and is a prominent feature of all properly constructed docks, whether with wooden or stone floors.

In a report on the wooden dock at St. Johns, by Mr. KEATING, the City Engineer, Halifax, he gives the quantity of water discharged by the drainage pump, due to leakage and surface drainage, at 965 galls. per minute; and this large volume of water must pass under the floor, and keep a portion of the timbers damp. That the exhalations given off from damp and decaying timbers, under the heat of a midday sun, can be healthful for the workmen is, Mr. BOSWELL considers, a matter open to considerable doubt.

Mr. DEVEREUX.—The following remarks must be accepted as the results of practical working experience, rather than as touching upon the scientific construction of any kind of graving dock. In the writer's opinion the design of the dock is excellent, especially the arrangement of the engines, centrifugals, discharge culverts, and entrance piers, and is, no doubt, all that could be desired for facilitating the docking and repairing of ships, if the structure is watertight, and the dock can be kept dry at a small expenditure of fuel.

On this latter point the whole economy of a dock, as a paying institution, rests. What with the wear and tear of the machinery, added to the cost of fuel and other stores, and the continually increasing leakage eroding away the foundations of the structure, a dock that leaks much will always be a continual source of trouble and expense. On this point the writer wishes to be clearly understood, because from his own experience he does not consider concrete impervious to water under great pressure. During the construction of the dock precautions seem to have been taken to guard against leakage from every direction, especially at the bottom; but whether this proved effectual after the cofferdam was removed is not stated.

In some docks, differently constructed from this one, the floor has been lifted by the pressure of water underneath; but, of course, such a case must depend much upon the nature of the surrounding formations and the stratum on which the floor of the dock rests. It was only last year that the construction of a dock at Portland, Ore., similar to the one under discussion, had to be abandoned on account of this water pressure. In the province of British Columbia drift gravel, hardpan, or till overlying rock is a good bed to build upon, and is usually very free from springs and leakage crevices.

There remains another very important matter to be considered in the construction of the dock question: Is it advisable to build docks of such large dimensions of wood and concrete only?

In the writer's opinion it is not desirable to do so, as it is to be supposed that such docks are built for the accommodation of large vessels only. Smaller and much cheaper ones would answer all purposes for small craft, and then a wooden structure would be strong enough, and last for many years if the timber were well covered with concrete, and kept continually wet.

To come now to the practical working of a large dock, and taking for example the docking of one of the Atlantic liners, say of 6,000 tons. If this vessel's keel is straight, and she preserves a perfectly uniform bearing on the keel blocks, there will be no difficulty experienced with the docking of the ship; but as a rule these vessels, after having been in use for a while, do not preserve their original lines, but sag down in the middle, or where the greatest inside weight is; and when the vessel is docked in this condition, it is obvious what the effect will be upon the keel blocks and the floor of the dock. Quite recently, there was a vessel of this description docked at Esquimalt, and the owners thought it necessary to have the ship raised higher than the usual keel blocks admitted. For this purpose the best Douglas fir that could be found in this Province was used. Though warned as to the result, they thought they would risk the consequences, and when the ship was landed on the structure built of 12 in. by 12 in., she crushed it down like so much match-wood. Of course, pitch pine bears a greater crushing strain than our fir, but this is merely mentioned as an example of what might be expected if the above 6,000-ton ship had been ashore, and possibly hogged, or if large portions of her keel had been removed in several places, the ship being at the same time probably loaded, and two or three compartments full of water. What then would the effect be upon the bottom of a wooden dock of such great length, with the keel of the vessel resting upon the blocks in two or three short spaces only, and not continuously along the whole length of the ship? Take the case of one of Her Majesty's ships of the first class, say of 11,000 tons, with her coal, stores, and battery all on board. She must be docked at once, for she is leaking, and part of her keel gone; however, she must be docked in that condition How would it fare with a wooden structure in such a case? No doubt it would suffer badly, and the captain of any such vessel would be loth to put his ship in a wooden dock, unless it were to save her from sinking.

There is a wooden dock 450 ft. long at San Francisco, similar to the one under discussion; but no ironclad has been in it up to date, and it is a well known fact that the floor of the dock has suffered considerably under much less weights than above described. Moreover, it is not very many years since one of H. M. ships on this station got ashore, and had to go to San Francisco to be docked, where she went on the United States pontoon dock at Mare Island navy yard—broke it down, ruined the ship, cost the Imperial Government $150,000 to repair the dock, and after all, when the ship went home, she was condemned, and never again went into commission.

Mr. H. F. PERLEY.—The builders of the dry dock at St. Johns, Newfoundland, Messrs. Simpson & Co., of New York, claim that by their system of constructing in wood, the cost of such structures is reduced to a minimum, and therefore it should be adopted in preference to constructing in stone.

Mr. BURCHELL does not give the cost of the dock at St. Johns, neither is it given in an "Official Report of a Board of Inspectors, ordered by the Secretary of the U. S. Navy" to examine that dock, but the sum of $556,000 appears in a report submitted by Mr. E. H. KEATING, City Engineer of Halifax, N. S., to the Mayor of that city, on an inspection he made in December, 1884.

Taking the length as stated by Messrs. BURCHELL and KEATING, the cost per lineal foot may be placed at $1,000, and this without any allowance for land damages, or customs dues on materials, machinery, etc., which were admitted into the colony free of duty.

In January last the U. S. Government called for tenders for the construction at League Island navy yard of a timber dry dock 500 ft. in length, 130 ft. in width at the top, and 50 ft. at the bottom, with a width of 80 ft. at the entrance, and a depth of 25½ ft. on the sill, with caisson, culverts, pumping plant, etc., complete, and the only offer received was from the Messrs. Simpson, whose price was $548,700 for the dock complete, and $975 per lineal foot for any length over 500 ft.

The (stone) dock proper at Esquimalt, B. C., cost about $1,500 per lin. ft., which included land, coffer-dam, unwatering, caissons, valves, pumping machinery, buildings, etc., and when called upon to estimate the cost of extending that dock a length of 100 ft., the writer placed it at $1,000 per ft., that being the actual cost of constructing *one foot* of the body of that dock.

It is extremely questionable whether a wooden dock at a cost of $975 per ft. can claim any character for cheapness when compared with the dock at Esquimalt, where labor and materials are higher than on the Atlantic coast; and certainly, on the score of permanency, maintenance, and repairs, the stone structure has the pre-eminence, and thus the claim for cheapness falls to the ground.

On this point it is well to quote from the report by Mr. KEATING, referred to herein: "It is claimed for wooden docks that their comparative cheapness should outweigh all other considerations. The American patentee claims that 'the original cost is less than one-tenth that required for a permanent stone dock,' and if this, or even a much higher value had been fixed as their true worth, there would be no need for further argument in their favor. An examination into the facts, however, shows that, in some cases at least, their actual cost has not fallen short of a fair price for a similar stone structure in a favorable locality. The two wooden docks at Brooklyn are reported as having cost as they stand to-day $1,283,356 (exclusive of interest), or say $640,000 each, although they are both operated by the same set of pumps; and in the case of St. Johns, if the value of the land and the remitted duties be added, it will be found that the actual cost of the dock at that port has been about the same sum. A carefully designed permanent stone dock with all its appendages, under similar favorable circumstances, and suitable building materials within a reasonable distance, would not in my judgment prove any more expensive."

Electric Apparatus for South Africa.

It is estimated that there are about from 150 to 200 electric street railways in this country either in operation or in course of construction, while electricity is also being largely used as a source of power for mining purposes. The foreign contracts of American electrical companies are also becoming very considerable. Among recent contracts which have been awarded is one to the Sprague Electric Railway & Motor Co., of New York, for electric mining apparatus which is to go to the Transvaal, South Africa. The order is from the Forbes-Reef Gold Mining Co., through Chester & Gibb, mining engineers, of London, England, and is for a complete electrical equipment for transmitting power, including four Sprague long-distance motors and dynamos for transmitting 140 H.P. over a distance of 3 miles. The source of power is a waterfall, situated about 3 miles from the mines, as the crow flies. The connection is by insulated wires which are carried on poles.

At the power station will be placed 3 belted wheels furnished by Fraser & Chalmers, of Chicago. To each of these wheels will be belted one long-distance transmission constant potential Edison dynamo of 50,000 watts, or 67 H. P. capacity each. To the other wheel will be belted a dynamo of the same type and voltage as the others, but of only 40,000 watts or 55 H. P. capacity. These dynamos are similar in appearance to the standard Edison dynamo which is used in incandescent lighting, but their winding is modified according to the regular Sprague system, adapting them for the long distance transmission of power. These machines are said to have an efficiency of over 93 per cent.

At the mines are located the four Sprague motors, which are belted directly to the pulverizing concentrators. These motors are divided into two groups. Two 20 H. P. Sprague motors and one 80 H. P. motor forming one group, and a single 20 H. P. Sprague motor forming the other group. Each group is supplied with current by a separate set of wires, thus practically insuring a constant flow of electricity under all circumstances.

The regulation of the motors and keeping up of a constant speed, in spite of the varying loads thrown on the mining machinery, is accomplished by winding the motors in a special way, so that there is no mechanical governor to get out of order. The governor being in the winding, and consequently acting without making any movement, the motors are claimed to be more durable, and the use of any complicated mechanical governor is avoided. The motors are to run on a constant potential circuit, and all the motors of each group are connected together from positive to negative wires, thus equalizing the strain on the dynamos when the loads are thrown on the motors. This method of connecting dynamos and motors is in use in all Sprague stations for the transmission of power, and is claimed to be much superior in reliability and economy to the series method of putting each motor on a separate connection. Its principle is likened to the supplying of a city with water by tapping city mains instead of by using a separate conductor for each consumer.

The question of efficiency or loss between the prime mover and the working machines is claimed to be very much in favor of electric transmission under conditions like these. In this case the efficiency of the entire system, from the turbine pulley to the mining machines at the farther end, is fully 70 per cent., that is 70 per cent. of the energy which is delivered from the turbine pulleys at the power station is given off the motor pulleys for work.

COST OF ELECTRIC LIGHTING.—The Montreal *Star* recently gave the following figures in connection with a proposed extension of the electric light system. "An arc light of 2,000 c. p. costs as follows in the places mentioned:

	Per annum.	Per night.
East Liverpool, Ohio	$ 90	24½ cts.
Toledo	100	27⅓ "
Bridgeport, Conn	90	24⅔ "
Hamilton, Canada	102	28 "
Toronto, Canada, this year 300 lights contracted	90	24¾ "
Quebec, Canada	80	22 "
Montreal	146	40 "
Montreal (outside districts)	164.25	45 "

Incandescent lights in same proportion, $22.66, giving 6 incandescent lights to 1 arc, while it is claimed that two incandescent lights would hardly represent one gas light, which costs only $20 per annum. The corporation is therefore paying equal to $49.32 for an incandescent light, as against the same volume of light by a gas lamp costing $20 per annum, without the necessity of the poles in the streets."

A Light Portable Air Compressor.

The two cuts here given well illustrate the purose of the designer in producing an air compressor that will admit of easy transportation, and thus make this machine available in situations otherwise inaccessible. No one piece weighs over 300 lbs.; and Fig. 2 explains better than words the manner in which this desirable end has been attained.

The compressor itself is the well-known Ingersoll-Sergeant machine made by the New York company of that name. Its special features are an improved form of air cylinder, an automatic air regulator, and a new swivel cross-head. In this machine the air and the steam end are equally durable. The cooling is effected by an improved form of jacket instead of by admitting water into the air cylinder; and this cylinder is efficiently and automatically lubricated by an ingeniously devised oil cup. The automatic regulator for air and steam is a peculiar improvement. It is not a throttling valve, but an

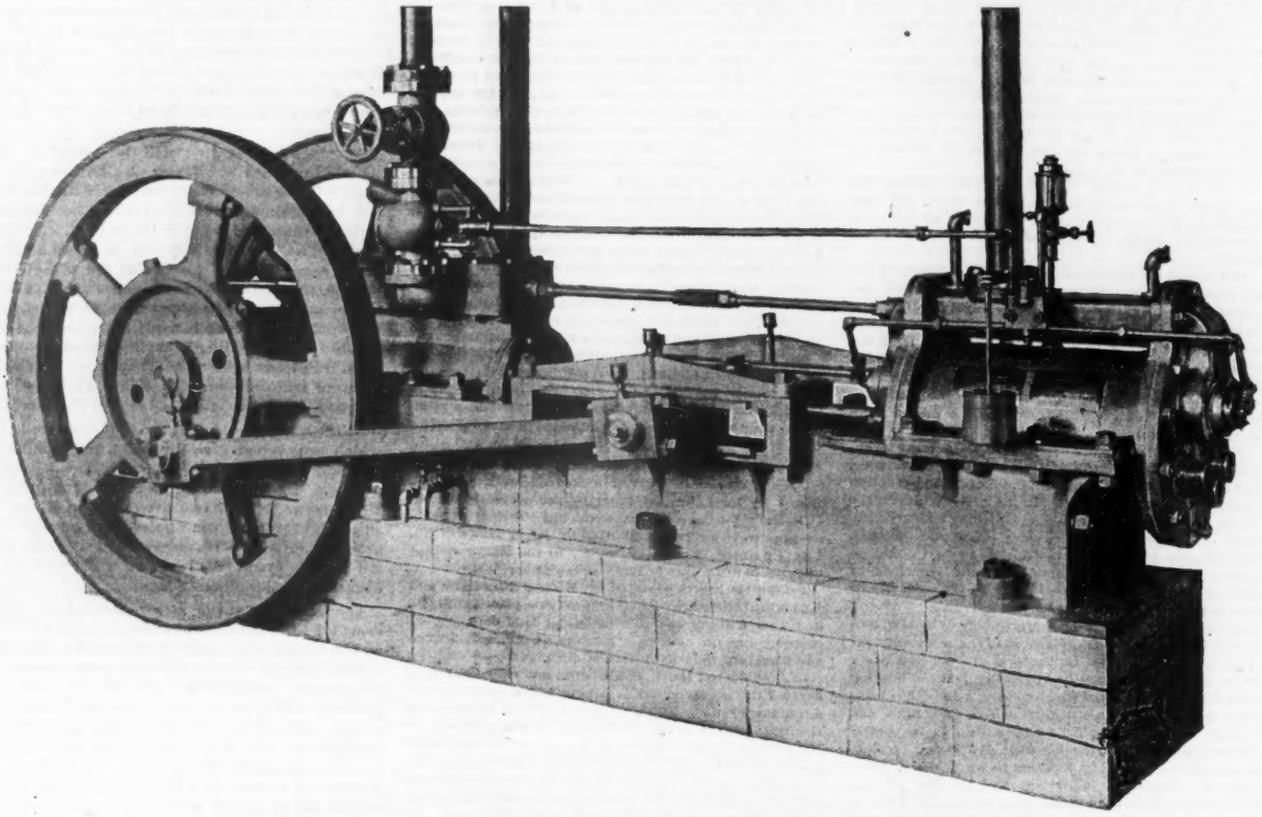


Fig. 1. Ingersoll-Sergeant Air Compressor.—Built for Light Transportation.

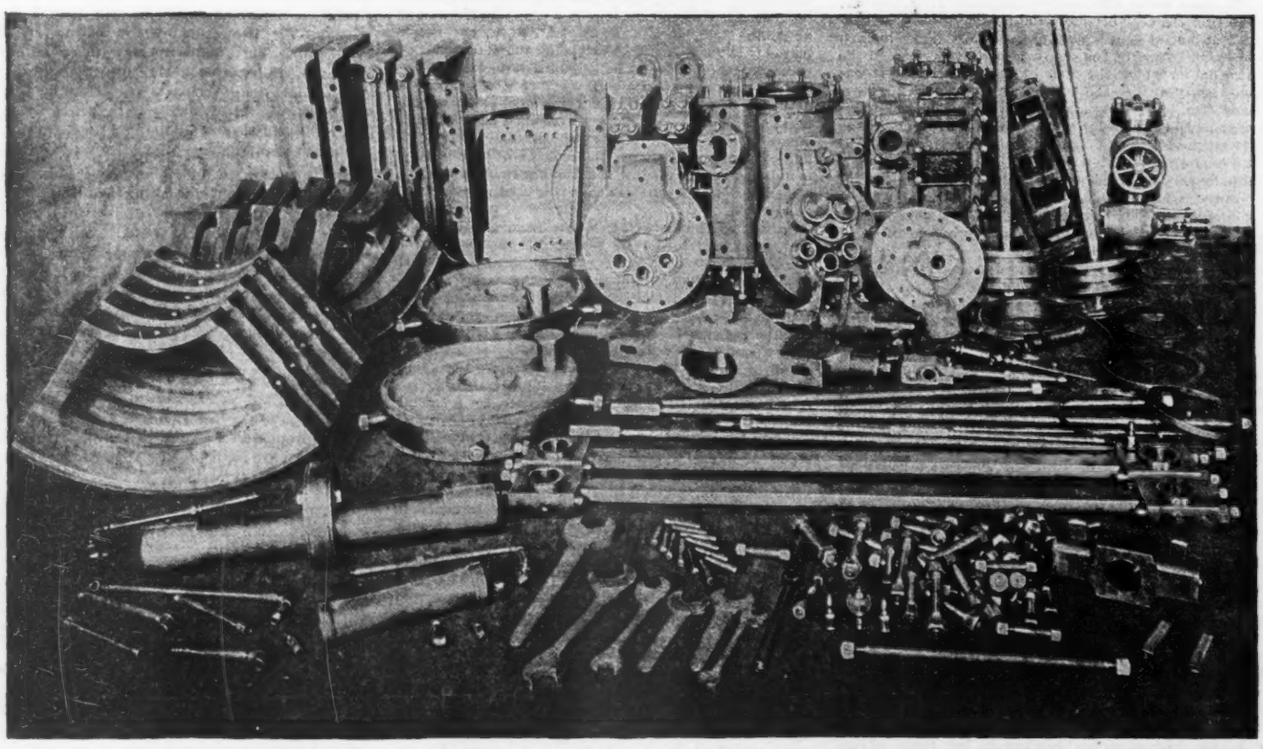


Fig. 2. Ingersoll-Sergeant Air Compressor,—Knocked Down for Light Transportation.

tomatically controls the admission of steam and the discharge of compressed air in such a manner that the power applied is just in proportion to the work demanded from the machine.

Both's Precise Section-Liner and Scale-Divider.

The cuts given herewith shows a new scale divider and section liner recently devised and patented by A. C. Both, Civil Engineer, Portland, Maine. From actual test in this office we can speak very highly indeed of it. The instrument is very simple in construction; the motion is positive, requiring the pressure of the finger only; and the work it performs comes about as near as is practicable to being absolutely accurate. It requires but one push of the finger for each line of any shading or hatching with spaces from ¼-in. to $\frac{1}{200}$-in. apart, while the adjustment for different spacings requires but a moment. The instruments are made

Fig. 1. Both's Section-Liner and Scale-Divider.

entirely of metal, are well finished, and ought not to wear out or get out of order readily.

The rack in the center of the straight edge, Fig. 1, is accurately cut, having 24 teeth to the inch. The plate, which is nicely fitted to slide on this straight edge, is moved at each pressure upon the knob—by means of the steel pawl engaging with the teeth of the rack—a distance equal to one, two, or more teeth of the rack, according to the vertical adjustment of the pawl, which may be made to take in at once from 1 to 6 teeth. It will now be seen that if the ruler arm is set at a right angle to the straight edge, or at 90° on the arc, it will also be moved at each push a distance equal to one, two, or more teeth, producing lines $\frac{1}{24}$, $\frac{1}{12}$, ⅛, ¼, to ½-in. apart. The progressive motion for each push upon the knob is in a practical sense positively accurate, and equal to the graduation of the rack or some multiple thereof. From Figs. 2 and 3 it will be seen that the division of the rack can be reduced in any desired ratio, dependent upon the angle to which the ruler arm is set. The ratio of reduction of the base, expressed in decimals, is always the natural sine of the angle to which the ruler arm must be set to produce the required reduction.

If, for instance, it is required to reduce the 24 divisions of the rack (or 1 in. of its length) to a length of one-half an inch, the ratio is $\frac{1}{2} = 0.5$, which is the sine of 30°; the ruler arm being set to this angle, and the pawl adjusted to engage with adjacent divisions of the rack, the reduction can be made with the greatest accuracy. This holds good for any ratio of reduction. The following table gives required angles for commonly used inch scales, having inch and half-inch divisions.

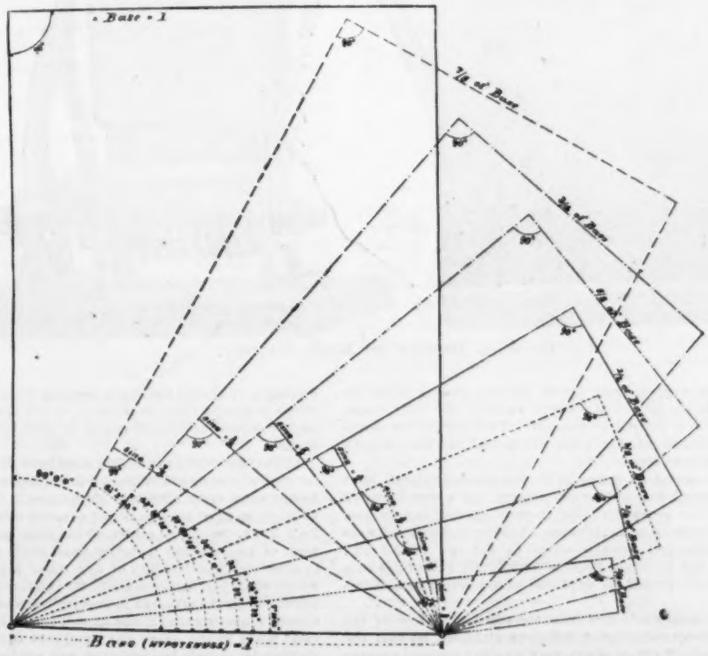


Fig. 2. Diagram Explaining Working of Both's Section-Liner.

Ratio of reduction, or scale.	Ratio in decimals, or sine of angle.	Corresponding angle for ruler arm.
1/6	0.125	7° 10′ 51″
¼	0.25	14° 28′ 30″
3/8	0.375	22° 1′ 27″
½	0.5	30° 0′ 0″
5/8	0.625	38° 40′ 56″
¾	0.75	48° 35′ 25″
7/8	0.875	61° 2′ 42″
1	1.0	90° 0′ 0″

To produce scales of 1½ or 3 ins. to a foot, it is simply necessary (the instrument being set for a ¾-in. scale) to draw a ¾-in. scale twice for the 1½ in., and four times for the 3-in. scale, when there will appear ¼-in. divisions in the former and ⅛-in. divisions in the latter scale.

In like manner an inch scale can be drawn, having either ¼-in. or ⅛-in. divisions, by using the ⅛-in. scale-setting twice, or the ¼-in. scale setting four times.

That this instrument is eminently adapted for section lining is apparent. Any possible shading from 4 to 200 lines to the inch can at once be produced, needing only one push upon the knob for each line. The rapidity with which it can be worked depends upon the dexterity of the draughtsman in the use of his pen or pencil. By reason of its accuracy, the operator will have to attend only to his pen and the limits of his lines, and will find its use a pleasure rather than a drudgery, to say nothing of the great relief to his eyesight. A sample card of different shading like Fig. 4, only larger and more varied, may be prepared, each shading being marked with corresponding angle for ruler arm and the number of divisions of rack used. This will enable the draughtsman to select the desired shade, and to reset the instrument in a moment, so as to reproduce shading like any sample. Since the introduction of the blue-print process line shading has become more a necessity than ever, and if done perfectly it imparts a decidedly neat look to any drawing.

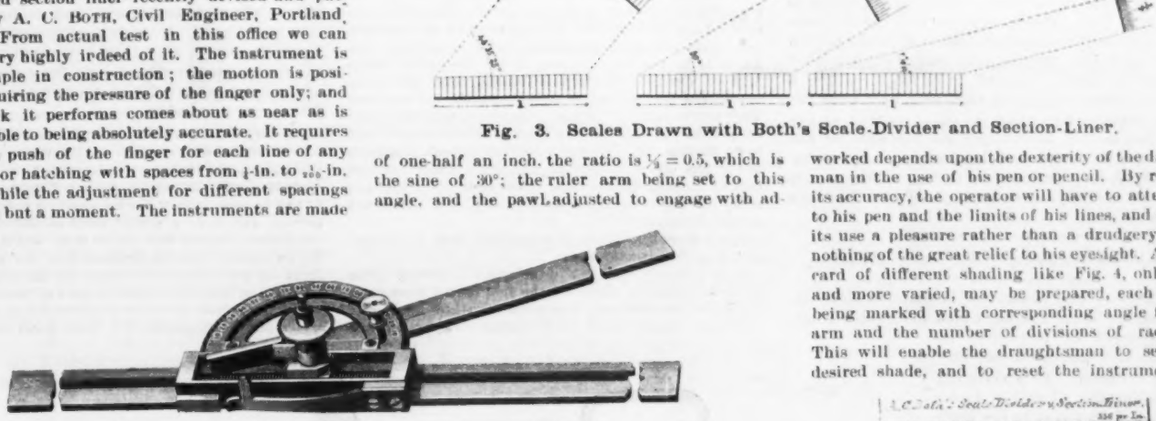


Fig. 3. Scales Drawn with Both's Scale-Divider and Section-Liner.

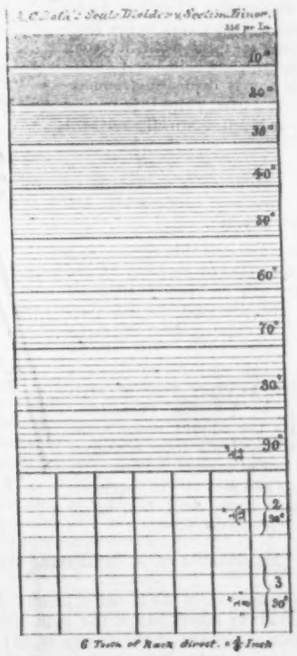


Fig. 4. Sample of Work (Engraved Full Size) Both's Section-Liner.

Various persons besides ourselves who are using these instruments, speak in the highest terms of their neatness, simplicity, and accuracy. They are finely finished and seem to us likely to become a favorite and almost indispensable tool in every office where much draughting is done. There are a great variety of devices of this general nature, but we recall none which has impressed us as so good.

The instruments are at present manufactured for and sold by the patentee, A. C. Both, Civil Engineer, Portland Me., and are sent express paid for $12.

Grand Prizes at the Paris Exposition have been practically awarded, says the N. Y. *Times*, to the Motive Department of the Pennsylvania R. R. Co. for model cars; to Edison, to the Thomson-Houston Co., and to the Bell Telephone Co. for electrical appliances; and to the Rensselaer Polytechnic Institute, the Boston Institute of Technology, and the U. S. Agricultural Department for educational exhibits.

To Estimate Brick Work.

The Boston *Journal of Commerce* gives the following: Ordinary bricks are about 8 ins. in length, and with the mortar joint about half that in width, so that each brick, on the flat, will give horizontal surface of about 32 sq. ins., or 4½ bricks will cover 1 sq. ft. As ordinarily laid, there are 9 courses to every 24 ins. or 4½ to the ft.; 4½ courses, with 4½ bricks to the course, will give 20¼ bricks to the cubic foot. Waste, cutting, and closer joints will easily require an allowance of 21 bricks per cu. ft., which will be found a very convenient figure for estimating the number of brick required for a wall of given height and thickness, as it thus becomes unnecessary to find the cubic contents of the wall, but merely to multiply its face area, or the product of its length and height in feet, by seven-fourths of its thickness in inches, which, as the thickness is always some multiple of 4 ins. is a very simple process.

The Crescent Battery for Rock Blasting.

The battery here illustrated is claimed to be the only battery in the market which discharges a uniform current of electricity regardless of "personal equation" in the operator. This certainty and uniformity of action is accomplished by fixing to the lever and rack-segment shaft a strong spring which is coiled or tightened by slowly depressing the handle. At a fixed point this handle or lever is automatically released from contact with the shaft, and the spring in its recoil gives a rapid and uniform movement to this armature, generating the electric current.

The tension of this spring, and consequently the capacity of the battery, can be readily adjusted by a nut provided for this purpose. The spring itself is practically indestructible. The advantages of this uniform current are manifest to every user of electricity in blasting operations, and its use should remove the risk of accidents from miss-fires and a lack of current volume. It is made and sold by the Ingersoll-Sergeant Rock Drill Co., of 10 Park Place, New York.

The Crescent Battery for Rock Blasting.

Explosions of Illuminating Gas.

The Committee of the Board of Electrical Control, appointed to report upon the explosions in the electrical subways at the corner of 23d St. and Fifth Ave. state the facts bearing upon the subject, and remedies which seem to be necessitated by the condition of the streets in the city of New York, underground in a brief and apparently very fair report, which is in substance as follows:

THE EXPLOSIONS AT 23D STREET.

The explosions at 23d St. were caused by the rapid accumulation of illuminating gas in the manholes of the electrical subway from a leak in the gas mains adjacent thereto, which illuminating gas was ignited presumably by a spark resulting from the atmospheric differences of temperature or by a flame carried backward through the distributing duct leading from the subway into the cellar of a store in the Fifth Avenue Hotel, which distributing duct had been left unclosed. It does not appear that the explosions were caused by any leak from the electrical conductors in the subway, inasmuch as the evidence before the Board shows that no current had been turned on these conductors at the time of the explosion.

The important conclusion derived from the investigation, therefore, is that such explosions are primarily due to escape of gas, and may occur as well in the telephone and telegraph subway as in the electric light subway, and may also occur in sewers, house vaults, or other confined spaces in which illuminating gas may accumulate.

This conclusion is supported by the following additional facts arrived at in the course of the investigation:

First. Other subway manholes have exploded in which no electrical conductors were being operated at the time of the explosion.

Second. Four explosions in the sewers have taken place during the last year.

Third. Explosions in the sewers have occurred in other cities from the escape of illuminating gas, notably very recently in Philadelphia and in London.

Fourth. Violent explosions destroying houses have occurred in Pittsburg from accumulations of natural gas.

VENTILATION OF SUBWAYS.

It appears that the engineers in charge of the construction of subways in the city of New York have recognized the fact that the accumulation of illuminating gas, from defective gas-pipes, in the manholes, was likely to be a serious menace to the successful operation of electrical conductors underground, and have considered the subject in all its bearings. It has been their aim to exclude the gas from the manholes, so far as possible, by constructing them of solid masonry; and upon finding that even this would not answer, inasmuch as the gas creeps in through the place where the iron casting forming the manhole cover rests upon the masonry of the manhole, they discussed and attempted means of ventilation.

The different methods of ventilation may be divided into four classes, as follows:

1. By means of openings in the manhole covers. This is objectionable by reason of the fact that a horse passing above the manhole, or a carelessly thrown stump of a cigar or cigarette, or the dropping coals from a passing fire engine, may ignite the gas issuing from the holes in the manholes, thereby causing the very catastrophe it is desired to prevent. This method of ventilating manholes has been attempted in Chicago with most serious results.

2. By means of a gas-jet in the manhole itself, kept constantly burning near the bottom, and a vent through which the current of air thereby excited can escape. This is objectionable, because a sudden leak in a manhole of a defective gas-pipe—such as the one in 23d St., where the manhole became sufficiently full of gas in a very short period to explode—would result in a blow-out.

3. By means of vents from the top and bottom of the manhole terminating at different altitudes, so that the difference of temperature may excite a current passing in through the one vent and out through the other, which current may be accelerated by means of patent ventilators placed upon one of the vents. This has been tried, by direction of the Board of Electrical Control, on Broadway, and, while a certain slight current is excited, which might be satisfactory under ordinary circumstances or in some particular place, it is not sufficient to meet the requirements of the subways everywhere or in all cases.

4. By means of blowers or air compressors, by which the gas is forced out of the subways and kept out by an air pressure along the entire construction. This method achieves the best results. A blower is at work in the cellar of the Marlborough Hotel, and another in the basement of 18 Cortlandt St.; and the subways where these machines reach are free from gas, generally speaking.

The Board of Electrical Control can, by compelling the use of blowers or air compressors and the forcing of fresh air through the subways wherever subways are constructed, effectively obviate the danger of explosions, except in cases of free leaks of gas in large quantities and will undoubtedly do so. But, while this action on the part of the Board of Electrical Control will reduce the chances of explosions in the electrical subways, it will increase the danger in house vaults, sewers, and other places to which the gas may be driven.

The report then points out the obvious fact that the gas and steam companies have no right which permits endangering the public safety, and that the escaping of gas into the streets of the city is due to carelessness in the construction of the gas mains, the use of improper material, and the lack of proper care and repairs. It is not at all necessary that, because companies are allowed to conduct gas under the streets, they should also, as the president of one of the companies declared, "have the right to leak." The report concludes:

The very volatile natural gas used in Pittsburg, under a pressure 30 times as great as that under which the illuminating gas in this city is carried, is kept within bounds; and, if this can be done in Pittsburg, it certainly can be done in New York; and it is only because the natural gas is in a degree more dangerous that extra precaution is taken with regard to it. Let it be conceded for an instant that this responsibility for what escapes from the gas pipes is not upon the gas companies, and the natural deduction must be allowed that should electrical companies allow their electricity to escape, they would not be responsible for what it did in the way of damage; or should the steam heating company allow its steam to escape from its pipes, it would not be responsible for whatever damage might be done by the escaping steam.

At the time when it was first suggested that the electrical conductors should be placed underground rather than be operated upon unsightly structures in the streets, to the detriment of the safety and comfort of the citizens of New York, those who possessed the same belief in the fitness of the existing practice were loud in protesting against the practicability of any other arrangement by which electrical business could be conducted. The electrical companies declared in every place where they could obtain a hearing that it was utterly impossible to operate their wires in any other way; and that they had certain rights which must be respected, and continued to them. When they were given an opportunity of devising a plan for placing their electrical conductors underground, they found it impossible to do so. The result of their conservatism was that the people declared to them: If you cannot find a way for relieving the streets, we will find one for you. And so it has proved. And the wires are going underground, and the poles are falling at the rate 2,500 per annum.

The same mode of procedure must be pursued with reference to the encroachments of the gas companies and the steam companies and others doing business underground. If they are unable to conduct their business in such a manner as to preserve the rights of others, and to subject the streets, the electrical subways, the sewers, and the house vaults to the least possible disturbance, they should be shown how to do so and compelled to conform to proper police regulations in the enjoyment of their profitable privileges.

There is to-day in the city of New York no public authority vested with power to reform the abuses which exist in our streets underground. The commissioner in charge of streets has to do only with the replacing of the

pavements when they are disturbed, and cannot even refuse permission to a gas company to tear up the streets, or make any conditions as to how its mains shall be laid, or its pipes tested or ventilated, provided the pavement is replaced to his satisfaction.

The Health Department, which is perhaps the most powerful police regulator in the city of New York, can do nothing except in cases of very apparent carelessness, and even then cannot designate the way in which repairs shall be made or to what tests the gas and steam mains and other underground constructions shall be submitted.

The Committee, therefore, recommends: First. That the Consolidated Telegraph and Electrical Subway Company, in charge of the subways, be directed, under the supervision of the Engineer of the Board of Electrical Control, to make such further provision for blowers and air compressors as may insure such safety as can be had from explosions in the subways.

Second. That the attention of the local authorities be called to the condition of affairs in the streets underground in the city of New York, and that the Corporation Counsel be requested to draft such a measure as will devolve upon some competent municipal board the same control over the streets underground and over all underground construction as is at present exercised by the Board of Electrical Control in the case of the subways for electrical conductors, and that all the local authorities be invited to join with the Board of Electrical Control in petitioning the Legislature and the Executive of the State of New York for the passage of such an act.

Graphical Method of Calculating Bridge Strains for Concentrated Loading.

BY WARD BALDWIN, C. E.
Prin. Asst. Eng. C. N. O. & T. P. Ry.

The investigation of the condition of maximum shear given in the article under the above title, published in these columns Sept. 28, applies to the simple truss, but not to the simple girder. The diagram (given to working scale on page 296 of issue of Sept 28) can with equal facility, however, be used to find the position of the loading producing the maximum shear at any point of a simple girder.

Suppose the train to be moving toward the left, and to enter upon a simple girder $A\ B$, then the maximum shear occurs under wheel 1 until the train has passed on the girder so far that $\frac{\Sigma.w\ d}{l}$ for wheel 2 over a point f is greater by 8.000 lbs. than $\frac{\Sigma.w\ d}{l}$ for wheel 1 over the same point; where d is the distance of any load w from the right-hand pier. At this point f the shear will be the same whether wheel 1 or wheel 2 is over the point, and for all points further from the right-hand pier the shear will be greater under wheel 2 than under wheel 1. At this point f, where the shears under wheels 1 and 2 are equal, we shall have

$$\left\{\Sigma.w\ d_2 - 8{,}000\right\}\frac{1}{l} = \frac{\Sigma.w\ d_1}{l}$$

where d_2 is the distance of any wheel from the right-hand pier when wheel 2 is at the point f, and d_1 is the corresponding distance when wheel 1 is at the same point of the girder. Let the distance of f from the right pier be designated by x_1.

Now for the assumed loading the space between wheels 1 and 2 is 8 ft., and therefore the value of x_1 is such that the sum of the moments of all the wheels about a point at distance x_1 from wheel 1 is less than the sum of the moments of all the wheels about a point at a distance x_1 from wheel 2 by (8000. l) ft. lbs.

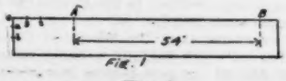


Fig. 1.

Now mark on a slip of paper, as Fig. 1, the length of the girder $A\ B$=54 ft. and place this slip on the diagram with A at wheel 1, then the ordinate between (O, M) and (1, 1,) at B will be (8000 l.) ft. lbs. Mark off this ordinate (O, a) on the left vertical edge of the slip, measuring from the upper corner; and from the same corner lay off the distance between wheels 1 and 2, namely 8 ft., on the horizontal edge of the slip. With these edges of the slip of paper kept vertical and horizontal, move the slip on the diagram keeping the point 2 on the Moment Line until the point a also is on the Moment Line. The distance from wheel 1 to the left vertical edge of the slip is now evidently x_1, and the maximum shear at any point between the right-hand pier and a point at the distance x_1 from it will occur under wheel 1.

This value of x_1 for the 54-ft. girder is found by scale to be 13.6 ft. Now as the train moves to the left, the maximum shear at any point more than 13.6 ft. from the right-hand pier occurs under wheel 2 until the train has passed on the girder so far that $\frac{\Sigma.w\ d}{l}$ for wheel 3 over a point g is greater by 20,000 lbs. than $\frac{\Sigma.w\ d}{l}$ for wheels 2 over the same point. The shear under wheel 2 at g is $\frac{\Sigma.w\ d_2}{l} - 8{,}000$; and the shear under wheel 3 at g is $\frac{\Sigma.w\ d_3}{l} - 28{,}000$. And the point g is at such a distance x_2 from the right-hand pier that

$$\frac{\Sigma.w\ d_2}{l} - 8{,}000 = \frac{\Sigma.w\ d_3}{l} - 28{,}000\ ;\ \text{or}$$

$$\frac{\Sigma.w\ d_2}{l} = \left\{\frac{\Sigma.w\ d_3}{l} - 20{,}000_l\right\}\frac{1}{l}$$

At this point g the shear will be the same whether wheel 2 or wheel 3 is over the point, and for all points farther than x_2 from the right-hand pier the shear will be greater under wheel 3 than under wheel 2.

Now for the assumed loading, the space between wheels 2 and 3 is 4½ ft., and therefore the value of x_2 is such that the sum of the moments of all the wheels about a point at the distance x_2 ft. from wheel 2 is less than the sum of the moments of all the wheels about a point at a distance x_2 ft. from wheel 3 by (20,000. l) ft. lbs.

Now place the slip of paper $A\ B$ on the diagram, with A at wheel 2, then the ordinate between (1, 1) and (2, 2) at B will be (20,000 l) ft. lbs. Mark off this ordinate (o, b) on the left vertical edge of the slip measuring from the upper corner, and from the same corner lay off the distance between wheels 2 and 3, namely 4½ ft., on the horizontal edge of the slip. With these edges of the slip of paper kept vertical and horizontal, move the slip on the diagram, keeping the point 3 on the Moment Line until the point b is also on the Moment Line. The distance from wheel 2 to the left vertical edge of the slip is now evidently x_2, and the maximum shear at any point farther than x_2 from the right-hand pier will occur under wheel 3. This value of x_2 for the 54-ft.-girder is found by scale to be 72 ft.; hence for all points more than 13.6 ft. from the right-hand pier, the maximum shear occurs under wheel 2.

It will be found that the assumed loading here used will produce a maximum shear when either wheel 1 or 2 is at the given point of any simple girder, but it may occur with other loadings that the maximum shear will exist under some other wheel than the first or second, and then the above method of procedure may be followed.

Take for example the loading specified by the Pennsylvania Railroad Company, consisting of two passenger engines coupled and followed by a uniform load of 3,000 lbs. per lin. ft.

The maximum shears in a 54-ft. girder due to this loading are found as follows, with the use of a diagram constructed as above. To find the value of x_1 (the distance from the right-hand pier at which the shear under wheel 2 equals the shear under wheel 1), lay off on the upper left corner of a slip of paper like Fig. 2 $(O, 2)$, the horizontal distance between wheels 1 and 2, and (O, a) the vertical ordinate between (O, M) and (1, 1) at 54 ft. from wheel 1; now place the slip on the diagram so that a and 2 are both on the Moment Line, then the distance from the left edge of the slip to wheel 1 is x_1; this scales 42½ ft.

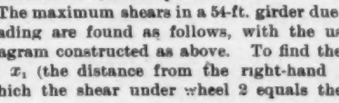


Fig. 2.

Hence, up to a distance of 42½ ft. from the right pier, the shear is greater under wheel 1 than under wheel 2; beyond this point, the shear is greater under wheel 2.

To find the value of x_2 (the distance from the right-hand pier at which the shear under wheel 3 equals the shear under wheel 2), lay off on the upper left corner of the slip of paper $(O, 3)$ the horizontal distance between wheels 2 and 3 and (O, b) the vertical ordinate between (1, 1) and (2, 2) at 54 ft. from wheel 2; now place the slip on the diagram so that b and 3 are both on the Moment Line, then the distance from the left edge of the slip to wheel 2 is x_2; this scales 13.4 ft. Hence at any point more than 13.4 ft. from the right-hand pier, the shear is greater under wheel 3 than under wheel 2; but the shear is greater under wheel 1 than under wheel 2 for all points up to a distance of 42½ ft. from the right pier; therefore the maximum shear never occurs under wheel 2, and it is necessary to find the value of x_3, the distance from the right pier at which the shear under wheel 1 equals the shear under wheel 3. To do this, lay off on the upper left corner of the slip of paper $(O, 4)$ the horizontal distance from wheel 1 to wheel 3, and $(O, c) = (O, a) + (O, b)$; now place the slip on the diagram so that c and 4 are both on the Moment Line, then the distance from the left edge of the slip to wheel 1 is x_3; this scales 23 ft. Hence, up to a distance of 23 ft. from the right pier, the maximum shear occurs under wheel 1; beyond this point the maximum shear occurs under wheel 3.

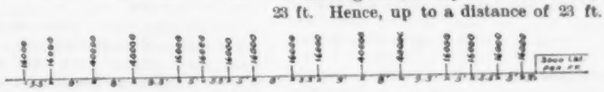


Fig. 3.

ERRATA in article published Sept. 28.

Page 295, middle col., 17th line; read 160 ft. instead of 1.6 ft. 29th line should read "intersection of."

Page 297, first col., 18th line; read

$$S = R\frac{a}{l} - \Sigma_a\ W\frac{Pe}{p}.$$

50th line; between "first" and "wheels" insert the words "wheel stands at d the first three."

Fostering American Shipbuilding.

In answering a query of the Baltimore *Morning Journal*, Mr. HENRY W. CRAMP, a member of the well-known shipbuilding firm of Philadelphia, speaks as follows on the subsides paid by France to shipowners and regarding the measures which in his opinion should be taken to encourage shipbuilding in America. Mr. CRAMP says:

In order to build up the American merchant marine, American registration of American-built ships must be continued; the coast-wise traffic must be limited as now to American-built ships; the Government should pay on such American-built ships as engage in foreign traffic a premium for navigation in proportion to mileage and tonnage.

The French pay construction premiums as follows:

On wooden ships over 200 tons, $4.00 per ton.

On wooden ships under 200 tons, $2.00 per ton.

On iron ships, $12.00 per ton.

On machinery, $2.40 per 100 kilogrammes.

On boilers, $1.60 per 100 kilogrammes.

The running premiums are on a fixed scale of 30 cents per ton for each 1,000 miles to French-built vessels, diminishing at the yearly rate of one cent per ton.

Steamships built on plans approved beforehand by the Naval Department receive 15 per cent. additional bounty.

Give American shipping such a stimulus as is given to the French. We have the requisite raw materials and we have the mechanical skill.

Those who advocate free material seem to think that ship materials are like merchandise, that may be imported in quantities and kept on the shelves till wanted This is not the case. Each ship's material has peculiarities of its own, and these cannot be determined till the ship is contracted for and laid down.

American plate-mills, foundries, and forges are now developed to a degree that renders domestic supply certain in quantity, and the competition insures a fair range of prices. A free material bill would demoralize these industries and impair their reliability as a source of supply. A law providing free material for ships to be built on foreign account has long been in force. Very little use of it has been made by American builders.

All the industries connected with ship-building in this country are now in a most satisfactory condition, having just passed through the transition stage from iron to steel.

The Origin of Museums.

At the late Newcastle-on-Tyne meeting of the British Association, the President, Prof. W. H. FLOWER, in his inaugural address spoke as follows of the origin of museums or public and private collections of interesting material of every character :—

The first recorded institution which bore the name of museum, or temple or haunt of the Muses, was that founded by Ptolemy Soter at Alexandria about 300 B.C.; but this was not a museum in our sense of the word, but rather, in accordance with its etymology, a place appropriated to the cultivation of learning, or which was frequented by a society or academy of learned men devoting themselves to philosophical studies and the improvement of knowledge. Although certain great monarchs, as SOLOMON of Jerusalem and AUGUSTUS of Rome, displayed their taste and their magnificence by assembling together in their palaces curious objects brought from distant parts of the world—although it is said that the liberality of PHILIP and ALEXANDER supplied ARISTOTLE with abundant materials for his researches—of the existence of any permanent or public collections of natural objects among the ancients, there is no record. Perhaps the nearest approach to such collections may be found in the preservation of remarkable specimens, sometimes associated with superstitious veneration, sometimes with strange legendary stories, in the buildings devoted to religious worship. The skins of the gorillas brought by the navigator HANNO from the west coast of Africa, and hung up in the temple at Carthage, afford a well-known instance.

With the revival of learning in the Middle Ages, the collecting instinct, inborn in so many persons of various nations and periods of history, but so long in complete abeyance, sprang into existence with considerable vigor, and a museum, now meaning a collection of miscellaneous objects, antiquities as well as natural curiosities, often associated with a gallery of sculpture and painting, became a fashionable appendage to the establishments of many wealthy persons of superior culture. All the earliest collections, comparable to what we call museums, were formed by and maintained at the expense of private individuals; sometimes physicians, whose studies naturally led them to a taste for biological science; often great merchant princes, whose trading connections afforded opportunities for bringing together things that were considered curious from foreign lands; or ruling monarchs, in their private capacity. In every case they were maintained mainly for the gratification of the possessor or his personal friends, and rarely, if ever, associated with any systematic teaching or public benefit.

One of the earliest known printed catalogues of such a museum is that of SAMUEL QUICKELBERG, a physician of Amsterdam, published in 1565 in Munich. In the same year CONRAD GESNER published a catalogue of the collection of JOHANN KENTMANN, a physician of Torgau, in Saxony, consisting of about 1,600 objects, chiefly minerals, shells, and marine animals. Very soon afterwards we find the Emperor RUDOLPH II. of Germany busily accumulating treasures which constituted the foundations of the present magnificent museums by which the Austrian capital is distinguished.

In England the earliest important collectors of miscellaneous objects were the two JOHN TRADESCANTS, father and son, the latter of whom published in 1656 a little work called "Museum Tradescantianum; or a Collection of Rarities preserved at South Lambeth near London." The wonderful variety and incongruous juxtaposition of the objects contained in this collection make the catalogue very amusing reading. Under the first division, devoted to "Some Kindes of Birds, their Egges, Beaks, Feathers, Clawes, and Spurres," we find "Divers sorts of Egges from Turkie, one given for a Dragon's Egge;" "Easter Egges of the Patriarch of Jeruseleum;" "Two Feathers of the Phœnix Tayle;" "The Claw of the Bird Rock, who, as Authors report, is able to trusse an Elephant," Among "whole birds" is the famous "Dodar from the Island of Mauritius; it is not able to flie, being so big." This is the identical specimen, the head and foot of which has passed through the Ashmolean into the University Museum of Oxford; but we know not what has become of the claw of the Rock, the Phœnix tayle, and the Dragon's egg. Time does not allow me to mention the wonderful things which occur under the head of "Garments, Vestures, Habits, and Ornaments," or the "Mechanick, Artificial Workes in Carvings, Turnings, Sowings, and Paintings," from EDWARD the Confessor's knit gloves and the famous "Pohatan, King of Virginia's habit, all embroidered with shells or Roanoke," also still at Oxford, and lately figured and described by Mr. E. B. TYLOR, to the "Cherry-stone, upon one side S George and the Dragon, perfectly cut, and on the other side 88 Emperours' faces," or the other "Cherry-stone, holding ten dozen of tortoise-shell combs made by EDWARD GIBBONS."

But before leaving these private collections I cannot forbear mentioning, as an example of the great aid they often were in advancing science, the indebtedness of LINNÆUS in his early studies to the valuable zoölogical museums which it was one of the ruling passions of several kings and queens of Sweden to bring together. Upon the association of individuals together into societies to promote the advancement of knowledge, these bodies in their corporate capacity frequently made the formation of a museum part of their function. The earliest instance of this in our country was the museum of the Royal Society in Crane Court, of which an illustrated catalogue was published by Dr. GREW in 1681.

Detroit Street Pavements.

The Detroit *Free Press* evidently thinks that the pavement question in that city needs overhauling, and concludes that Detroit has as yet comparatively little to show for the expenditure of about $5,000,000 in paving and repairs.

The Nicholson pavement of sawed blocks, laid on tarred boards on a sand foundation, lasted for about twelve years on some streets; but bad drainage caused dry rot, as a rule. The cedar blocks gave better results in wear, durability, and ease of repair. The Board of Public Works figure that the cedar block pavement will last 8 years before extensive repairs become necessary, but that it is better to begin repairs earlier. The concrete base to wooden pavements has not been tried in Detroit, and hence the surface of the pavement is usually very bad.

Detroit has 121.4 miles of paved streets, and 242.75 miles of unpaved streets. The expenditure upon these streets since 1849 has been $4,455,618; and on alleys $203,255 more. This account does not include cost of repairs, which would add $387,187. Since 1884 cedar block pavement seems to have been the favorite. This pavement is made of sound blocks stripped of bark, cylindrical in shape and not more than 9 ins. nor less than 5 ins. in diameter, and 7 ins. deep. These blocks rest on a bed of bank sand and gravel, 6 ins. deep, well rolled and shaped to the street, the roller weighing 2,400 lbs. After the blocks are set by an 80-lb. rammer, the spaces between them are filled with screened gravel rammed in with steel bars, and again pounded with an 80-lb. rammer, 12 ins. in diameter. The finished pavement is finally covered with gravel and sand to a depth of ¾ in.

The *Free Press* gives some elaborate tables of cost of paving and repairs, which convey little or no information, however, as to the character of the pavements referred to. The trouble seems to be that the authorities of Detroit want a cheap pavement that will last indefinitely, with a minimum of repairs. Like all other good things in this world, really good pavements of any kind are expensive, and if wanted must be paid for. If Detroit prefers wood pavements, as seems to be the case, the citizens should adopt the London methods in wood paving, and, as suggested by the *Free Press*, put into a durable concrete base some portion of that money now expended in repairs and continual relaying. A good foundation is at the bottom of all success in street paving in more senses than one.

ELECTRICAL NOTES.—The maximum power generated by an electric motor is 75 H. P., but experiments indicate that 100 H. P. will be reached.—— The greatest candle power of arc light used in a lighthouse is 2,000,000 c. p., in a lighthouse at Housholm, Denmark.

PERSONAL.

Gen. JAMES L. LANSING, at one time Treasurer of the Buffalo & Erie R. R., died recently at Canandaigua N. Y.

Mr. EDWIN THACHER, Bridge Engineer and Contractor, has removed his business from Decatur, Ala., to 258 W. Main St., Louisville, Ky.

Mr. W. E. LEWIS, Superintendent of Telegraph on the Long Island Railroad, has been appointed Assistant Superintendentof the road.

Mr. H. CRAWFORD, Jr., the new General Manager of the Indiana Midland road, has appointed Mr. C. R. BARNHART, Superintendent, and Mr. HENRY MOORE, Traffic Manager.

Mr. RUDOLPH HERING, Mr. J. E. JACKSON, and Mr. EATON, City Engineer, have been appointed by the City Council of Los Angeles, Cal., a committee to report on the system of sewerage.

Mr. CHAS. A. ANDERSON died in New York on Oct. 6, aged 83. Mr. ANDERSON was graduated from Columbia College in 1826, and was Chief Topographical Engineer on the New Haven Railway when it was built, and is said to have located that road. He was a ripe scholar and assisted WILLIAM CULLEN BRYANT in translating the Odyssey. He was a stock and bond broker for many years.

Mr. CHAS. C. MOWTON, for many years connected with the Manhattan and the Consolidated Gas Companies of New York, died Oct. 2. He was born at Baltimore, Md., in 1833. In 1860 he entered the employ of the Manhattan Gas Co. as its Assistant Chief Engineer, and four years later he became its Chief Engineer, which position he held until the consolidation of the various companies. Since then he has been General Superintendent of the entire outside work of the Consolidated Gas Co.

Mr. NORMAN W. WHEELER, Mechanical Engineer and Marine Architect, died in Brooklyn, N. Y., Oct. 7. In the early part of the civil war he designed the engines and other machinery of the double-turreted U. S. ironclad ram *Keokuk*, which sank during the first attack by a Federal fleet on Charleston. Later he designed all the new transports built for the U. S. Government by the Cramps, of Philadelphia. After the war, he became identified with marine interests on the Great Lakes, and designed some of the most successful of the huge iron vessels built by the Union Dry Dock Co., of Buffalo. He invented important improvements in steam pumps.

Mr. JAMES KIMBER, M. I. C. E., and for thirty years the Chief Engineer to the Corporation of Calcutta, was the recipient of a very handsome complimentary dinner given on Aug. 7 at the St. Stephen's Club in London. Among the guests were such well-known English engineers as Sir C. DOUGLAS FOX, Mr. JAMES LIVESEY, and Sir G. B. BRUCE. Mr. JAMES KIMBER is a brother of his host, Mr. HENRY KIMBER, Member of Parliament and well known in New York by his connection with the Rugby colony of Dr. THOMAS ARNOLD, and also a brother of Mr. ALFRED KIMBER, formerly a member of the New York Stock Exchange.

BOOK REVIEWS.

Second Annual Message of EDWIN H. FITLER, *Mayor of the City of Philadelphia, with Annual Report of* LOUIS WAGNER, *Director of the Department of Public Works, and Eighty-Seventh Annual Report of the Bureau of Water for the year ending December* 31, 1888. Issued by the City of Philadelphia, 1889. Cloth, 6 by 9¼ ins. pp. 349. Many diagrams and tables.

The Second Annual Message of Mayor FITLER is a summarized review of the work done by the various municipal departments during the year 1888, and contains suggestions regarding future policy and action. The bulk of the volume is taken up with the report of Mr. JNO. L. OGDEN, Chief Engineer of the Bureau of Water, but in addition the work of the Bureaus of Gas, Highways, Street Cleaning, and Surveys is set forth by Mr. LOUIS WAGNER, Director of the Department of Public Works.

BUREAU OF GAS.

The streets of the city are lighted by gas, gasoline, and electricity. The gas-works are owned and operated by the city, with the exception that 415 lamps are furnished by the Northern Liberties Gas Co. The gasoline and electric lighting is secured by contracting with private corporations. The number of the various lamps, and the cost to the city of all those furnished by companies, is shown for 1888 by the following figures :

	Number.	*Cost.*
Electric arc lights	756	$120,134
Gasoline lamps	5,932	131,302
Gas lamps supplied by the Northern Liberties Gas Co., Under charge of Bureau of Gas	415	9,430
	17,261	
Total	24,364	$260,866

In 1888, 2,034 of the lamps under charge of the Bureau of Gas were not lighted because of their proximity to electric lights. Public lights burn all night and every night in the year.

The cost of the lamps under the charge of the Bureau of Gas is included in the total expenditures of this Bureau, but is not credited to the Bureau, as it very properly might have been.

The total expenditures of the Bureau of Gas in 1888 were $3,321,962, of which $3,107,796 were for current expenses, and $214,166 for new holders and mains. The total receipts for the same year were $3,875,383, but of this $125,000 was from the Schuylkill River East Side R. R. Co. for damages to the Bureau's property. It is also to be noted that $3,281,353 of the receipts were for gas, $458,870 for residuals, and $10,160 for sundries. And it should be remembered that the Bureau has no credit for 536,158,081 cu. ft. of gas delivered to the various city departments and for street lighting, which at $1.50a thousand, the rate charged by the city to private consumers, would amount to $804,237.

The amount of coal carbonized in 1888 was 673,748,735 lbs. which produced 3,209,874,000 cu. ft. of gas, or 4.70 cu. ft. of gas to each pound of coal.

Of the total amount of gas manufactured, 470,736,019 cu. ft., or 12.87 per cent., is unaccounted for except by leakage and waste. At $1.50 per foot, this represents a loss of about $700,000.

In the past five years the cost of gas delivered to con-

sumers, including cost of extensions to the mains, has been reduced from $1.31 to $1.02, or excluding extensions, from $1.09 to $0.91. The corresponding decrease for gas in the holder has been from 73 cts. to 66 cts.

The gas mains were extended 39¼ miles in 1888 and now have a total length of 917 miles.

A contract for an additional daily supply of 3,000,000 cu. ft. of gas was made with the Philadelphia Gas Improvement Co. in 1888. Under this contract the company was to erect buildings and works and furnish "Hydro-Carbon or Water Gas" to the city at 37 cts. per 1,000 cu. ft. The city has the right to purchase the works whenever it may be able and desire to do so. The contracts with the company and the specifications for all parts of the works are given in the report under consideration. Mr. WM. K. PARK is Chief of the Bureau of Gas.

BUREAU OF HIGHWAYS.

This Bureau has for its Chief, Mr. GEO. A. BULLOCK. A total of nearly 29 miles of new pavement was put down in 1888 over 20 miles of old pavement improved, and nearly 8 miles of cobble stone pavement replaced with granite blocks, sheet asphalt, or vitrified brick. The total expenditures of this Bureau for 1888 were $895,441, and the receipts, $58,545.

BUREAU OF STREET CLEANING.

This Bureau went into operation Jan. 1, 1888, the street cleaning previous to that date having been done by the Bureau of Highways. There were removed during the year a total of nearly 900,000 loads of ashes, dirt, and garbage. The number of dead animals removed reached the astounding number of 16,355. The expenses of the Bureau were $441,514. Mr. SYLVESTER H. MARTIN is Chief.

BUREAU OF SURVEYS.

This Bureau has charge of the construction of sewers and bridges. In 1888 it built two bridges and nearly 33 miles of main, branch, and private sewers. Its expenditures were $569,569, and its receipts, $26,236. SAML. SMEDLEY is chief.

BUREAU OF WATER.

This bureau is under the charge of Chief Engineer JNO. L. OGDEN. Its total receipts for 1888 were $2,114,826, and its operating expenses, including the sum spent for extensions, were $1,193,907. There were, Jan. 1, 1888, 176,022 properties assessed for water rent. The total designed daily capacity of the pumping machinery is 185,200,000 galls. The average daily pumpage per capita per day for 1888, estimating the population at 1,020,083, was 100 galls. The cost per million gallons pumped 100 ft. high was $4.99.

Some very interesting statistical tables are given, concerning periods of years. For instance, the revenues per year for the ten years, 1879 to 1888, inclusive, are given in detail, showing the amount per year from the various sources. There is also a pumpage table for the 10 years, 1878 to 1888, inclusive, showing the number of gallons pumped to reservoirs each year, number pumped 100 ft. high, cost per million gallons of the latter, and estimated population.

During the year the northeast section of the East Park Reservoir was completed, thus increasing the storage capacity by 306,000,000 galls.

A striking and valuable feature of the report is the Pumpage Diagram for 1888. By the use of seven impressions, or colors, this diagram has been made to show graphically the number of millions of gallons pumped each day in the year, at each station, the total pumpage for each day in the year and the average weekly pumpage for the year; also the rainfall per day throughout the year, expressed in inches and quarter inches; the temperature at noon each day at Fairmont Reservoir, both of the air and the water; in addition, the level of water at the Fairmont Dam is shown for each day. This diagram is not only remarkable for the variety it shows, but for its perfect printing or lithography as well, the registering being almost perfect.

The hydrographic work of the Bureau of Water is in charge of Mr. JNO. E. CODMAN, whose report for 1888, relates almost wholly to the investigations made by him in connection with the search for new sources of water supply.

Table 1 of Mr. CODMAN'S report relates to the rainstorms of greatest intensity as recorded by the automatic gauges at the three observing stations, namely, the Bureau of Water, Philadelphia, Frederick or Perkiomen Creek, and at the Forks of the Neshaminy Creek. Table 2 shows the average percentage of rainfall reaching each of these streams each month for five years. March shows the greatest amount for the Perkiomen and Neshaminy, and February for the Tohickon. October is the month of least percentages. Table 2 also shows the maximum and minimum percentages of each month's rainfall which reach the three streams. For the five months June to October, inclusive, the Perkiomen has an average maximum percentage of 40, and minimum of 13, or total average of 22.6 per cent. The Neshaminy has an average maximum of 27, and an minimum of 4, or total average of 12 per cent. The Tohickon has an average maximum of 47, and an average minimum of 4½, or a total average of 19 per cent.

Table 3 gives the total yield of the three streams by months, with the average by days. Table 4 gives the average annual yield of these three streams for five, and the Sudbury (Mass.), and Croton (N. Y.), for six years, stating in each case the drainage area in miles, the yearly rainfall in inches, the average annual and daily yields in gallons, the average yield in cubic feet per second per square mile of drainage area, and the latter for each inch of rainfall. Table 5 gives maximum and minimum flows of the Perkiomen, Neshaminy, and Tohickon.

Table 6 gives the differences between the monthly precipitations on sundry watersheds, as observed by Mr CODMAN'S assistants, and those recorded by the United States Signal Service at Philadelphia. There differences are slight, and may be at least partially accounted for by differences in elevation.

Table 7 is a further study of the precipitation and the stream flow in the drainage areas of the Perkiomen, Neshaminy, and Tohickon creeks.

Table 8 is a more extended application of the comparisons given in Table 6, there being in Table 8 a larger number of observations and these extending over a wider area, and through the years 1883 to 1888, inclusive, each year beginning with October.

Mr. CODMAN'S report is supplemented by diagrams as well as by tables. Three of the four diagrams show the daily stream flow in cubic feet per second and millions of gallons per day for the three streams mentioned so often above. In addition, the diagrams show the rainfall and temperature for the same period.

The fourth diagram shows, for the same streams and observing stations, the yearly flow in cubic feet per month for the years 1883 to 1888, inclusive, each year beginning with October. This diagram also shows the rainfall.

Such tables and diagrams as we have just described are of great value to all students of water supply problems, or of the relation of the precipitation of rainfall to the flow of streams. Every year's observations add to the value of the records, and every new station is a great gain. We hope that Mr. CODMAN'S studies will facilitate the introduction of a better water supply into Philadelphia, and they surely will have that tendency if they are appreciatively studied by the city officials.

Bibliographie Géodésique, elaborée par Dr. O. BOERSCH. Berlin, Georg Riemer, 1889. 4to 228 pages.

A Bibliography of Geodesy. By Prof. J. HOWARD GORE, Washington, Government Printing Office, 1889. 4to 198 pages.

The almost simultaneous publication of two extended bibliographies of geodetic literature indicates that the importance of precise surveying is to-day more thoroughly understood and appreciated than ever before in the past. From time to time during the last fifteen years, we have taken occasion in these columns to urge the necessity of thorough and careful work in all kinds of measurements, often pointing to the precision of geodetic operation as an *ultima Thule*, which every surveyor should keep in his mind. The discussion of the errors of observations, their adjustment by the method of least squares, the devices for eliminating systematic errors, and other processes that have originated in the science of geodesy, have certainly influenced to a great extent the common methods of surveying, and are destined in the future to play a yet more important part in securing precision and accuracy. Geodesy is a vast science, and it may be a matter of surprise to many that two hundred or more quarto pages are required to give merely the titles of books and articles that have been written in its various departments; but if these bibliographies render the literature itself more familiar to the general public a good work will have been done.

The bibliography of Dr. BOERSCH was compiled at the request and published at the expense of the European International Geodetic Association. It is arranged according to the nationality of the authors, 21 pages being devoted to America (North and South), 5 to Belgium, 24 to Great Britain, and so on, thus making in all seventeen separate lists, each of which is subdivided into two parts, the first containing the official governmental publications and the second other works. It is difficult to see what useful end is gained by this arrangement, except that of comparing the geodetic activity of different countries, but its awkwardness is partially relieved by an alphabetical index of authors at the end of the work. There are no notes or remarks indicating the contents of the books and papers whose titles are given, and large numbers of titles appear to be taken from second-hand sources, as often the year of publication or the number of pages is unstated. It must not, however, be forgotten that work of this kind can never be perfect, and that scientific bibliographies should not be closely criticized from the point of view of a librarian. The list presented by Dr. BOERSCH contains the titles of work in all departments of geodesy, and is certainly more complete than any hitherto issued.

The bibliography of Prof. GORE is published at the expense of the U. S. Coast and Geodetic Survey, and will form an appendix to the annual report for 1887. Its arrangement is purely alphabetical, which is a great convenience, although this often involves some repetition and cross-references. Remarks following some of the titles serve to correct erroneous impressions that might otherwise be conveyed, and these will be found very useful to students. The division of each page into two columns and the use of different sizes of type render the work a fine specimen of the printer's art. From the title it would be supposed that the list covered the whole of geodetic science, but the preface states that the intention was to include only such works as related directly to the figures of the earth or described operations which could be used in determining that figure. As this does not give a perfectly clear idea of what is and what is not included, we have compared the list with that of Dr. BOERSCH, and find that in general Prof. GORE has omitted the subjects of azimuth, latitude, longitude, geodetic leveling, and map projections. As the rudest computation concerning the size of the earth must be based upon an astronomical observation, it is not plain why these topics should not have been embraced in the plan. Certainly they are of equal importance with base line measures, triangulation, and pendulum experiments in the derivation of the elements of our terrestrial spheroid and in adapting geodetic results to the practical uses of the public.

PUBLICATIONS RECEIVED.

—*The Abt System of Rack Railway for Steep Inclines.* This is a reprint of the valuable and interesting paper by the late Mr. WALTON W. EVANS, (Transactions of the American Society of Civil Engineers, March, 1885,) which is issued by Mr. W. HILDENBRAND, C. E., of No. 1, Broadway, New York, who is the representative in this country for the Abt system of rack railway. This system has been described and illustrated in ENGINEERING NEWS, and the first road to use it, in this country will be constructed shortly at Pikes Peak, in Colorado

—*Report of the Chief of Engineers* for the fiscal year ending June 30, 1888. 4 vols. 2,941 pp.

In these bulky volumes is contained a detailed account of the work of the U. S. Engineer Corps in improving the rivers and harbors of the country. Like almost all public documents, the present report contains a vast amount of chaff; but there is also much valuable matter, in which engineers who are interested in this work will find valuable information.

—*Ninth Report of the Railroad Commissioners of Kentucky* for the year 1888. I. A. SPALDING, JOHN F. HAGAR, W. B. FLEMING, *Commissioners.* 6½ x 9½ ins. very neatly bound in cloth; 293 pp.

The report is accompanied by an excellent map of Kentucky, prepared for the volume by the Kentucky Geological Survey.

—*Eighth Annual Report of the Railroad Commissioners of Alabama.* HENRY R. SHORTER, LEVI W. LAWLER, WILEY C. TUNSTALL, *Commissioners.* 6 x 9 ins., 514 pp. cloth bound.

—*Seventeenth Report of the Railroad Commission of Georgia,* (Nov. 1, 1888, to June 30, 1889,) CAMPBELL WALLACE, L. N. TRAMMELL ALEX. S. EWIN, *Commissioners* Pamphlet, 6¼ x 9½ ins., 131 pp.

—*Eighteenth Annual Report of the Railroad and Warehouse Commission of Illinois.* JOHN J. RINAKER, BENJ. F. MARSH, JASON ROGERS, *Commissioners.* 6 x 9 ins., 674 pp. cloth bound.

We shall review this report at length in an early issue.

—*Second Annual Report of the Railroad Commissioners of Florida.* GEO. G. MCWHORTER, ENOCH J. VANN, WM. HIMES, *Commissioners.* Pamphlet, 5¾ x 9 ins., 219 pp.

SOCIETY PROCEEDINGS.

General Time Convention.—The semi-annual meeting was held at the Hotel Brunswick, New York City, on Oct. 9. There are now 176 companies members of the Association, controlling 120,891 miles of road. About 70 delegates were present at the Convention.

The Committee on Car Service was made permanent, and in the future will consist of 9 members to serve for 3 years, 3 to be elected each year.

The convention decided to appoint a committee to be known as "the Committee on Safety Appliances," whose duty it shall be to consider what are the essential requisites in all devices for power brakes, automatic car couplers, interlocking switches, block systems, and for heating and lighting cars, and also as to what action should be taken by the convention with reference thereto.

The Committee on the Standard Code of Signaling reported that fifteen roads, operating 13,155 miles, had adopted the code in the last six months, making seventy-nine roads, operating 52,267 miles, now running under it.

The date for the adoption of the "mixed" plan of settling for car mileage, which had been fixed as Jan. 1, 1890, was likewise rescinded and the whole subject deferred for further consideration at the next meeting to be held in New York next April.

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Coming Technical Meetings.

American Forestry Congress. — Annual convention at Philadelphia, Pa., Oct. 15 to 18. Secy., J. B. Harrison, Franklin Falls, N. H.

Boston Society of Civil Engineers. — Next meeting, Oct. 16. Secy., S. E. Tinkham, City Hall.

American Society of Civil Engineers, New York. — Next meeting, Oct. 16. "Cast-Iron; Strength, Resistance, Tests and Specifications." Prof. J. B. Johnson. Secy., John Bogart, 127 E. 23d St.

Engineers' Club of Kansas City, Mo. — Next meeting, Nov. 4. Discussion on Sewerage Systems. Secy., Kenneth Allen, 310 Baird Building.

IT is unfortunate that a governmental difficulty, such as is recorded elsewhere, should arise so early in the life of the Nicaragua Canal and temporarily stop work on it, especially when, so far as an outsider can see, the complaining Government has somewhat the best of the argument, and a just right to complain. The facts in brief are these: Nicaragua, when giving the concession for the canal, had a pending boundary dispute with Costa Rica, which by award of the President of the United States was settled in favor of Costa Rica, which Government thus acquired territorial jurisdiction of the south bank of the San Juan River, but not jurisdiction over the river itself. The San Juan is to be slack-watered, however, and raised in level 40 or 50 ft., so as to flood far back into Costa Rica at points, and cover a narrow strip of its territory along the whole length of the river where the south bank forms the national boundary. All this flooded territory, it is true, is practically virgin wilderness, and largely worthless swamp land; but it does not lie in human nature for a poor and sovereign country, which has such a "pull" on a great enterprise like this, to neglect to avail itself of it. Accordingly the canal company was compelled to obtain a concession from Costa Rica also, at the price of $100,000 in cash and a block of stock, and also (what we understand to be the onus of the complaint of Nicaragua) a certain "99-year" reversionary interest in the canal which infringes on the previous similar concession to Nicaragua. To this Nicaragua, not unnaturally, has objected, and ordered that no actual construction work of any kind shall be done until the matter has been settled. It is likely to be settled by arbitration of the President of the United States if not by previous agreement, but in the meantime part of the construction force already sent down is idle, and financial negotiations are at a stand-still. It is reported, via San Francisco, that an agreement has been already reached, and work resumed.

NOTWITHSTANDING the fact that the American exhibit at the Paris Exposition was by no means as extensive and representative as it could have been made, the list of awards to Americans so far made public is a long one, and the character of the exhibits specially honored speaks well for our country. Educational institutions and scientific bodies come first on the list, and grand prizes were awarded to the Boston public schools, the Washington Bureau of Education, the Washington Bureau of Ethnography, U. S. Service of Meteorology, U. S. Commission of Geology, U. S. Coast and Geodetic Survey, U. S. Corps of Engineers, U. S. Geological Survey, U. S. Signal Service, Rensselaer Polytecnic Institute, Smithsonian Institute, and the Johns Hopkins University. Many other institutions received gold medals. Among publishers, the Century Company received the grand prize. American advance in art workmanship, of which we had little or nothing to exhibit in 1876, was here recognized by grand prizes awarded to the wonderfully beautiful Rockwood pottery and to the silverware of TIFFANY, and gold medals were given to the Gorham and Meriden companies for their exhibits in silver and plated goods. In electrical science, THOMAS EDISON heads the list of recipients of grand prizes, but ELISHA GREY, ELIHU THOMSON, and J. GRAHAM BELL were in like manner honored for their many and important discoveries and inventions. Among American railways the Pennsylvania Company seems to have been alone in receiving a grand prize, and this was awarded to the Motive Power Department for its model cars. Space forbids publishing the names of those awarded the gold medal for the excellence of their exhibits; but the number and variety of typical American industries represented at Paris augurs well for the exhibition on our own soil in 1892. We have much to show the world that is novel, useful, and beautiful; but doubtless the most striking exhibit of all to our continental cousins will be the wonderful advance made in the few years that have elapsed since 1876 and its Centennial Exposition.

THERE are indications that the Pacific coast ities will not offer the rich harvest to the securer of franchises and the promoter of private companies in the future that they have in the past. The Portland *Oregonian* declares that the giving away of valuable franchises should be stopped. "Every individual or company that applies for the privilege of laying rails and running cars through the street should be required to pay into the city treasury a fixed proportion of the earnings of the car line." It would seem that a statement so plainly true would hardly require proof. To pursue the policy of giving away valuable franchises at the discretion of the Board of Aldermen is to put a premium on such official corruption as that which disgraced New York City when the franchise for the Broadway surface road was publicly given away, and privately sold to fill the aldermen's pockets. No doubt, the quickest way to supply a city with public works is to turn over franchises for water-works, lighting systems, sewerage, and street railways as a free gift to the first corporation that applies for them; but the city that pursues so short-sighted a policy will find, when too late, the evil results of its error.

WE review elsewhere in this issue the annual reports of Mr. LOUIS WAGNER, Director of the Philadelphia Department of Public Works, and of Mr. JNO. L. OGDEN, Chief of the Bureau of Water in the same city. Philadelphia is the only large city in the United States which owns and operates the gas works supplying it, and one of the four or five cities in this country having gas works under public control. This fact makes that part of the report relating to the Bureau of Gas of especial interest.

The greater part of the volume is taken up with the report of the Bureau of Water, in which report the present condition of the water-works, and their operation in 1888, is very clearly set forth. As an appendix to his report, Mr. JNO. E. CODMAN presents some valuable tables and diagrams, relating more especially to the relation between the flow of certain streams and the rainfall upon their drainage area. The principal streams considered are the Perkiomen, Nishaminy, and Tohickon, all proposed future water-supply sources for Philadelphia. By way of comparison, some figures are given for the Delaware and Schuylkill and Croton (N. Y.) and Sudbury (Mass.) Rivers. These tables and diagrams are a valuable addition to this class of data.

SIR I. LOWTHIAN BELL, at the late meeting of the British Association, denied emphatically that "the day of fuel gas is rapidly approaching," as stated in a paper read before that body. He called the idea a great philosophical fallacy and claimed that the cheapest and most efficient method of obtaining heat for ordinary purposes was to burn the coal directly and not to attempt to use it in making a fuel gas. He said that out of 100 parts of coal 83 per cent. was utilized by burning, while 78 per cent. could be secured with water gas and only 71 per cent. from producer gas. This is probably a correct statement from the speaker's standpoint; but efficiency in applying the heat, and the elements of cleanliness and convenience which belong to a fuel gas, are often even of greater importance than economy in first cost; and in certain lines of manufacture, such as glass-making, these features make the difference between a good and a bad product.

Natural gas, and fuel gas made from the Lima oils, are certainly not included in Sir I. LOWTHIAN BELL'S comparisons, although he uses the general term of "fuel gas." Lima fuel gas is now being delivered for 5 cts. per 1000 cu. ft., and the statement is made that gas of this kind, equivalent in cost to 8 tons of coal, does the same work that formerly required the consumption of 40 tons of coal in 24 hours. This is probably an exceptional case; but the relative economy between coal and this fuel gas is very marked. As showing what natural gas has accomplished in the United States, we have the report of the Director of the U. S. Geological Survey for 1887, in which it is said that during the two previous years the total amount of coal displaced by natural gas was 19,500,000 tons, a quantity valued at nearly $31,000,000. Since then the quantity of coal displaced has been constantly increasing. Notwithstanding the opinion of Sir I. LOWTHIAN BELL, there is undoubtedly an immense and profitable field open to the use of a fuel gas generated by coal for domestic and certain industrial purposes,

Very Truly Yours
H. P. Jones

especially in districts like Chicago, where the consumption of soft coal direct is an almost unbearable public nuisance. Coal as a direct producer of heat will undoubtedly hold its own for certain uses and in certain districts for a very long time to come; but that the present methods of using coal as a prime generator of heat cannot be improved upon is a hasty statement, even from so high an authority as Sir. I. LOWTHIAN BELL.

A PARTICULARLY disagreeable and unwarranted grammatical error, which we have had occasion to note before, is becoming so common in the manuscripts which reach this office that it seems worth while to correct it again; viz, the practice of talking about "maxima loads," "maxima strains," etc., on the apparent ground that, as *maximus* is a Latin adjective, and as such "agrees with its noun in gender, number, and case," it should also be made to agree with an English noun. Such is not the case. We may with propriety use *maxima* as a plural noun, although it is likely that "maximums" will in time establish itself, as has happened with a number of other anglicized Latin words; but to give an adjective, of whatever origin, both a singular and plural form is wholly contrary to the genius of the English language. The error is peculiarly offensive because it comes, not from unpretending ignorance, which is always pardonable, but from an assumption of knowledge which does not in fact exist.

OUR esteemed contemporary, the *Iron Age*, hits the nail on the head in regard to the proper size of exposition grounds in the following pithy words:

> Another widespread idea is that a "big" acreage is a first consideration. Any one who has wandered about in the wilderness of second and third rate exhibits of any of the great world's fairs must have been convinced of the necessity of contracting rather than expanding these shows. There is no good reason why a dozen concerns who are rivals in making ugly and poor hats should be given the privilege to inflict hundreds of square feet of them upon an indifferent and tired public. In a good many industries collective exhibits carefully chosen should be insisted upon. Every legitimate effort should be made to keep the size of such a show within reasonable bounds. The simple fact that some person is willing to spend a good deal of money to show what nobody cares to see, ought not to be a sufficient justification to swell an unwieldy mass of articles. Until now a few thousand exhibitors have been allowed to largely defeat the objects of millions of visitors. It is to be hoped that, so far at least as the American section is concerned, a reform will be made in this direction in 1892.

This is directly in the line of what we have urged on this subject, and wherever the Fair may be held, we trust it will be remembered. Contract the area as much as possible, and reduce the exhibits to the really notable things, should be the governing rules. If this be done, the difficulty as to site is largely reduced; and if a large building in stories be decided upon, the difficulty vanishes. The *Iron Age* also expresses the view that the building of a tower a few feet higher than the Eiffel will "border on childishness," and be likely to fail of its object as well.

Two Systems of Train Operation.

We reviewed last week, as far as space and time would permit, three recent serious rear collisions, and referred to the block system as the only safeguard against such accidents. The serious nature of these accidents, and the amount of public interest they have excited, have turned the attention of railway men once more to the dangers which exist in and are inseparable from the ordinary system of train operations in use in this country. It may be worth while, therefore, to consider just what this system is to which we are still obliged to trust our lives, and just what safeguards are provided by the management of most of our railways to insure safety to their trains from collision while on the road.

The system of train movement by telegraphic orders, by which practically all American railway traffic is carried on, is admirably adapted to the use of small, single-track roads running few trains. The essential principle of the system is simplicity itself. Here is one man, the train dispatcher, who is, by means of the telegraph, in touch with every station on the line. He is the commanding general, at whose orders each train on the road moves or stands still. If he could at all times know the position of each train, and could at any time communicate with each, his task would be a simpler one. But, besides the danger that Jupiter himself may sometimes sleep, he can only know that a train is between certain points, and he can only communicate with it at stations. His orders must pass through several hands before their delivery, must be acknowledged by the recipients, often with numb fingers, and frequently read by no better light than that of a rain-spattered lantern. Does this system, however elaborated, leave loopholes for mistakes, resulting in the loss of life and property? Common sense says that it certainly must. The records of our train accidents show that it does, and not infrequently it breaks down through the concurrent carelessness of two, three, or even four employés.

Thanks to the intelligence of our railway employés in this country, however, serious head collisions are comparatively infrequent, rather less than a third of all that occur. Let us now consider what precautions are taken to prevent trains running in the same direction on the same track from colliding with each other. Here the train dispatcher has generally no responsibility. Of course, two trains are not sent out without an interval of a few minutes between them; but if the second train is a slower one, the interval may be very short. Just how short it is in the case of many of our lines of heaviest traffic, the traveling public, fortunately, for its peace of mind, does not realize. The modern practice of running the trains in sections has increased enormously the number of these closely run trains, and has had a natural constant tendency to increase likewise the number of rear collisions

The measures which are adopted to protect the rear of a train, when stopped on the road, are familiar to almost every one The rear brakeman must seize his lamp or flag, and go back along the track, placing torpedoes also in foggy weather, until he is far enough away to give the approaching train time enough in which to stop, when signalled, before striking the train ahead. Are there loopholes here for mistakes and failures? It is too plain for discussion that there must inevitably be such mistakes, and that the probability increases as trains grow more frequent. In two of the accidents referred to last week, the drunkenness of one employé and the bad judgment of another, combined in each case with the negligence of several comrades, resulted in the death of eight or nine innocent passengers.

At Palatine Bridge the engineer kept under way at reduced speed until the following train was too close to be stopped in time; but there are many possible accidents which might have brought about this collision, even supposing the judgment of the employés to be good in all cases. There is supposed to be an interval of ten minutes between trains, but it takes a very little slackening of the speed of the forward train to largely reduce this, and there are many causes which may operate to leave the flagman scant time to hurry back with his danger signal. Again, when the flagman goes back, the entire safety of the two trains depends on him. Suppose he is seized with a fit, is overcome by the cold of a winter night, falls in the darkness at some open culvert or cattle-guard and breaks a leg?

There is no need to rehearse these possibilities at length. The great number of rear collisions on our American roads is proof positive that the present system of protecting the rear of trains, on which so great reliance is placed, is inherently defective. It will take a long time to alter it, without doubt, and therefore all pains should be taken to improve it in so far as it is improvable by hastening the general adoption of the standard code of train rules and by such other ways as experience and ingenuity may suggest. But the fact should not be lost sight of that it is the system itself which is defective, in that it makes the safety of the train dependent on human vigilance merely, and taxes the employés who are expected to exercise that vigilance well up to the elastic limit in moments of emergency when the best men's judgment may differ as to the proper course.

Let us now see what is the essential principle of the other system of moving trains, commonly known as the block system. Here the whole road is divided into short sections, and signals are established at their points of division. If there is never more than one train on a block at a time, collision between two trains will be a mathematical impossibility. The engineer no longer has his attention strained at every point of his run, never knowing when a danger signal may flash out before him. He is able, therefore, to concentrate his unwearied sight upon the signals at the end of each section, that tell him whether the next block is clear.

We referred last week to the fact that the block system, which depends on the vigilance of the operators in the towers, is still defective. But in the automatic block system, there is no room left for failures of this sort. The passage of a train upon a block sets the semaphore at danger, and not until the train leaves the block at its farther end does the signal turn again to safety. The turning of the signal is accomplished by the train itself; and in order that no mishap to the signalling apparatus may cause an accident, the signal is so arranged that its normal position is at danger, and only by the correct working of the machinery can it be set at safety. Thus the worst that can happen by any mischance is delay, not danger.

A block system which fulfils these conditions, whether it be operated by mechanical or electrical means, is as safe as human ingenuity can make it; and so absolutely safe that a collision under it can only occur by intention or the grossest carelessness.

The other desirable features in such an apparatus are simplicity, durability, non-liability to derangement, and cheapness. Perhaps the last should be put first, since expense is the chief obstacle at present to a general introduction of the block system. We do not propose at this time to discuss the various systems which are now on the market further than to say that in the matter of cheapness and simplicity they all afford plenty of opportunity for inventive genius to improve on them. It does seem to be within the bounds of possibility that an automatic block system could be devised cheap enough to bring it within the means of the bulk of our American roads. The fortunate inventor of such a system will reap a great financial reward; but in

the meantime, while there may be some excuse for lines of thin traffic neglecting the block system, there is none whatever for lines of heavy traffic, like the New York Central, failing to use the appliances which now exist. At the most moderate estimate, there are today in this country at least 30,000 miles which ought to be operated by the block system, while in fact not a tenth of that amount is so operated.

In this detail of practice the English are far ahead of us, as shown in our issue of Sept. 21, and as a consequence we have the mortifying contrast—brought out with some definiteness in the article just referred to—that the American passenger has at least five times the chance of being killed or injured by causes beyond his own control that the British passenger has, and this in spite of the fact that in brake practice we are far ahead of the English, only 77 per cent. of their passenger vehicles having approved and semi-approved brakes on them, and the majority of these approved brakes being really of inferior types.

It must be recorded to our disgrace that there are practically no railways running in Great Britain which have not more effective protection in force against collisions than all but a trifling fraction of our roads. Out of a total of 18,687 miles, as we showed in our summary referred to:

10,179	have the absolute block system.
4,847	have both absolute block and train staff.
160	have train-staff and telegraph combined.
2,330	have the train-staff system.
484	have the single engine system.
388	have the train tablet system (experimental).
26	have permissive blocking.
18,414	have block system or some equivalent.

Of the English lines, 93 per cent. have the absolute block system; of the Scotch, 82 per cent.; of the Irish, 21 per cent. But the train staff system, which we have often explained, is a very fair substitute for a block system, and almost a sure preventive against collisions. Bearing in mind, also, that a still larger proportion of British switches and signals are interlocked, whereas we have only made a fair beginning in this line, the showing is most discreditable to us, and as respects our lines of heavier traffic positively disgraceful.

The fact that English practice is so all but universally in favor of the non-automatic tower system of block signalling, such as is used on the Pennsylvania, is justly entitled to great weight in favor of that system, and we have no word to say in opposition to it. Experience shows that it does occasionally fail, like all systems depending on human vigilance, but its failures are exceedingly rare. Our prepossessions are in favor of an electrical or some other automatic system, one which could be made absolutely certain in its action as respects maintaining safety conditions, and which ought to be likewise cheaper in operation if not in first cost. Such systems have already been brought to great perfection, and are, and have been for years, in use on many hundred miles of road. Some system of the kind ought no longer to be lacking on nearly half our mileage.

Exposition Prospects.

When a man finds he has taken a false step and has landed in the bog, his only true policy is to turn squarely about and get out of it, but his natural impulse is to try to preserve his consistency, and struggle forward somehow, even when he can see he is sinking deeper and deeper in the mire. It seems to us that the Exposition Site Committee has done and is doing just that thing. It is becoming every day clearer that the only real hope for holding the Exposition in New York is in a complete reconsideration of their first action, which practically excluded all sites but Central Park; but what they have finally concluded, after some weeks of evident vacillation, is to come out more explicitly than ever in favor of the free use of Central Park for buildings, which was in fact the only probable outcome from their first recommendations.

It is now explicitly admitted, what was always inherently probable, that within the selected area there is no way to get the needed land outside of Central Park except to condemn it. The committee estimate the cost of doing this at $12,000,000 to $20,000,000 and the interest charge on the valuation at $1,440,000 to $2,400,000, on a 4 per cent. and 3 year basis. In one way or another this would be quite sure to run up to our estimate of $3,000,000, which sum added to $6,500,000 for 65 acres of one-story buildings would make $9,500,000 for land and buildings, practically all lost after the Exposition is over. The committee plainly see that this is a greater burden than the project can bear, and therefore again, and more explicitly, fall back upon Central Park.

This second return to the park as a site has stirred up a more determined opposition than ever, and ought to do so; and as this opposition is quite certain to be strong enough to prevent the repeal of the State law forbidding such use of the park, and to be used very effectively in Congress in favor of Chicago, it is a serious error to incur it, whether it be really well grounded or not. We hold it to be thoroughly well grounded, and should therefore oppose such use of the park even if this Fair were the only one to be considered; but it is not. Paris has already had three successive Fairs in the Champs de Mars, in 1867, 1878, and 1889, and will undoubtedly have another in 1900. New York is becoming a great capital, and is likely to want to do the same thing. But what argument is there in favor of holding a Fair in Central Park in 1892 which will not apply, and with added force, to a similar use of it in 1901, 1912, 1925, and so on indefinitely? Are we prepared to permanently convert half of Central Park into a mere parade-ground, a Champs de Mars? To so abuse this lovely pleasure ground, "Nature's sweet marvel, undefiled," with no end of available vacant sites almost if not quite as accessible, and on the mere showman's plea that a few more dollars could thereby be collected at the gates, would bring on us in the end the contempt of the world, as a nation of barbarians

The only real chance for New York, and it is a grand chance, is for the committee to reverse (or rather expand) its action, frankly admit its mistake, and open to consideration at least two other sites of conspicuous merit, Inwood and Governor's Island; announcing also that at whatever site may be selected the needed area is to be reduced if possible by erecting a single large building in stories, with say 100 acres of floor space in a 20 acre building and if possible with sufficient park or other permanent reserved ground around it to give at least 120 to 150 acres for future expositions.

This done, difficulties will vanish. Inwood is an entirely suitable site, nearly if not quite as good as the Riverside site. A temporary two-mile extension along the Harlem River will enable trains of all three of the elevated lines to start from the grounds as a terminus. The time added to each visitor's trip will be some ten minutes or more, which is to be regretted, but comfort rather than time is what visitors most care for, and the comfort of visitors will be greatly promoted by having the Exposition station a terminus rather than a way station. The immense Hudson River, New York Central, Harlem, and New Haven & Hartford traffic could be better accommodated there. As a whole, there would be little if any difference in average convenience. We are confident that the committee can have had no well studied advice from experts in transportation to the contrary.

As for Governor's Island, its merits have been too little considered. It is no longer in any way needed by the Government for defensive or military purposes, and would be ceded to the city with a reversionary right in case of war, if it was evident that a proper national use was proposed. It is now 68 acres in size, and can be enlarged to about 200 acres (see map in our issue of Oct. 5) at a cost which may be approximately estimated at $1,650,000, as follows:

9,000 lin. ft. stone filled timber crib, average height, 22 ft., capped with stone wall 8 ft. high, at $75 per lin. ft	$675,000
Creosoting all timber in same, if necessary, at $25 per lin. ft.	225,000
Filling 130 acres, to an average depth of 24 ft. (material obtained from harbor dredgings and city ashes, etc., now dumped at sea); about 5,000,000 cu. yds. at 15 cts.	750,000
	$1,650,000

This work could be easily done in time for the Exposition if started this winter, and only part of it need be done at once. The great main building, being on the present island, would not be delayed by this work.

This would give the city a permanent harbor park of 200 acres, capped by a splendid permanent Crystal Palace of glass and iron, all available for world's fairs every ten years or so, as the Champs de Mars is in Paris, and in the meantime useful for various political and other gatherings, public entertainments and exhibitions, etc., etc., as well as for governmental use for barracks and storehouses in case of war or rumor of war. The cost of the made land would be some $11,000 per acre, all New York below 23d St. being now assessed at $210,000 per acre.

Surely this investment of $1,650,000 is better than to spend nearly twice that sum on mere rental of land which will be little if any more accessible. Out of the total of $9,500,000 which will be practically sunk at the Riverside site there would then be left $9,000,000 to put up a permanent building which would be the chief glory of New York harbor, worthily flanked on the right by the Bartholdi Statue, and on the left by the Brooklyn Bridge. A half-mile tunnel connecting the island with the Battery can be built if desired for $500,000, and 5 cts. each from 10,000,000 visitors would pay for it; but apart from this, it is to be remembered in considering the question of comparative accessibility (1) that about half the population of metropolitan New York lives in the Long Island and Jersey districts, which would be better served by Governor's Island than by any other site, and (2) that whereas the journey to and from either the Central Park or the Inwood site will be a pure burden of the flesh, the finest of all the exhibits at Governor's Island would be the general view of the Fair itself from the water in approaching and leaving it, especially at night.

The mind can hardly conceive, and certainly not from prior experience, the grandeur of effect which would result from a vast building, itself 200 to 400 ft. high, and combined with a great tower 600 to 700 ft. high, all brilliant with light in every part. The whole world would be anxious to see it, and see it again and again, so that the "drawing-power" of the Eiffel Tower ought to be far outdone. Had Paris, or London, or Vienna such a site as Governor's Island, and the free use of the three great American inventions

(as they chiefly are), which alone make such a building possible—elevators, electric lighting, and cheap and solid fire-proof floors—we may be quite sure that they would not long neglect to avail themselves of it; but no other large city on the globe, except New York, has even a site to permit of such a grand and unique effect. The more shame it will be to us, therefore, if we fail to avail ourselves of it, and merely slavishly copy, without necessity, what other cities have been forced to do for lack of the grander opportunity.

We feel the more free to speak in favor of the plan thus outlined because it is in no sense ours, but that of three eminent engineers and ex-Presidents of the American Society of Civil Engineers, Messrs. ADAMS, WORTHEN and MCALPINE, communicated in a letter to this journal Sept. 28. It has therefore by far the weightiest professional backing of any plan yet brought forward, as well as its own intrinsic merit in its favor. But whatever site be selected, there is still another consideration which tends strongly in favor of a single large building: But 29 months will remain for work after Congress meets if the Exposition is to open in May, 1892. The present Paris Exposition was 54 months in preparation. The 1876 Exposition was as far advanced as this is 48 months before it opened. It may prove an absolute necessity to postpone the opening until Oct. 12, 1892, the quadri-centennial of Columbus' discovery. A single building in stories could be heated, and the Exposition kept open through the winter and following summer; 65 acres of detached buildings could not be heated, and consequently the Exposition must perforce open at the earlier date if at all.

William Richard Jones.

[WITH PORTRAIT.]

The sudden death of Capt. WM. R. JONES, for so many years the manager of the great Edgar Thomson Steel Works, by the accidental bursting of a furnace, as noted last week, is an event which we are loth to permit to pass with the brief notice which alone was possible last week. As one of the foremost and most honored of American iron and steel experts, and as one whose qualities as a man and a citizen, as well as those strictly professional, had won the affection and respect of thousands, it is unfit that an engineering journal should notice his loss thus briefly. We give herewith, therefore, a portrait which is a faithful copy from his most characteristic recent photograph, and the following brief sketch of his busy and useful life.

WILLIAM RICHARD JONES was born in Luzerne Co., Pa., Feb. 23, 1839. His father, Rev. JOHN G. JONES, emigrated from Wales in 1832 and settled in Pittsburg, afterwards removing to Hazleton, Pa. WILLIAM commenced working early in life and after very limited "schooling." At the age of 10 he was apprenticed to the Crane Iron Co., of Catasauqua, Pa., in the foundry department, and later was placed in the machine shop. By the time he was 14 he made such great progress that he was receiving journeyman machinist's wages.

In 1856 he moved to Philadelphia and went to work. From there he journeyed to Clearfield County, where he was engaged as a lumberman, raftsman, and farm hand until 1858. In 1859 he went to Johnstown and worked at his trade for the Cambria Iron Co. After working there three months he went to Chattanooga, Tenn., where he remained until the breaking out of the war, when he was compelled to fly north with his young bride, having been married April 14, 1861, to Miss HARRIET LLOYD. In the following year, July 31, he enlisted as a private in Company A, 133d Pennsylvania Volunteers, and was promoted to the rank of Corporal. He was in the Army of the Potomac and participated in the battles of Fredericksburg and Chancellorsville, where he distinguished himself by personal bravery, being badly wounded, but refusing to leave the ranks. On the expiration of his term of service he returned to Johnstown, and once more went to work for the Cambria Iron Co., but he soon organized Company F, 194th Pennsylvania Volunteers, and was mustered in as Captain July 20, 1864, and assigned to duty in command of the provost guard at Baltimore, in which office he served until the end of the war, when he was honorably mustered out June 17, 1865, with a complimentary order from Gen. LEW WALLACE.

Capt. JONES then began what was to be his life work, again entering the service of the Cambria Iron Co. as assistant to the chief engineer, and assisting in the construction of the Cambria Co.'s Bessemer steel converting and blooming mill plants. He subsequently became Master Mechanic, and finally General Superintendent of the Edgar Thomson Steel Co., and directed the building of furnaces A, B, C, D, E, F, and G, the third of which was destined to become the cause of his untimely death.

His improvements and inventions are admitted to have made these furnaces almost, if not quite, the finest in the world. His inventions were numerous. The first were "A Device for Operating Ladles in Bessemer Process" and "Improvements in Hose Couplings," patented Dec. 12, 1876. In the same month he also patented fastenings for Bessemer converters. His other more important patents were washers for ingot molds, 1876; hot beds for bending rails, 1877; apparatus for compressing ingots while casting ingot molds, 1878; cooling roll journals and shafts, 1881; feeding appliance for rolling mills, and art of making railroad bars, 1886; appliance for rolls, apparatus for removing and setting rolls, housing caps for rolls, roll housings, 1888; and apparatus for removing ingots from molds, 1889.

His latest and, it is said, greatest invention is a method for mixing metal taken from blast furnaces and charged into two receiving tanks. Letters patent on this invention have been allowed, but are not yet issued.

In 1888 Capt. JONES was appointed consulting engineer to Carnegie, Phipps & Co. He was one of the earliest members of the American Institute of Mining Engineers, the American Society of Mechanical Engineers, and of the Engineers' Society of Western Pennsylvania, and was also a member of the Iron and Steel Institute of Great Britain. He was a prominent G. A. R. member, and was, in 1888, chosen Senior Vice Commander of Pennsylvania. He was a Freemason and a staunch Republican.

Capt. JONES had four children, only two of whom survive, namely, a son, W. M. C. JONES, now engaged as engineer in the Edgar Thomson Steel Works, and a daughter CORA. Both children have attained their majority.

In his dealings with his workmen Capt. JONES was always open-handed, and showed a considerate attention to their welfare. He was necessarily at times compelled to assume an attitude of determined opposition to their demands, but was yet so fair with them as to secure and retain their good will. For example, during strikes he never made any move to start the works until he had first notified the leaders of the strikers when he was going to resume.

During the trying times after the Johnstown disaster Capt. JONES did noble work. He at once took several hundred workmen to the stricken city, and was said to be the coolest and most efficient man there when clear-headed men were so badly needed.

We are pleased to learn that Capt. JONES possessed and left behind him a comfortable fortune for his family, in spite of having been habitually a large giver to charitable purposes. His salary and royalties together are said to have amounted to about $50,000 a year, and the company is said to have presented him last year with $100,000 worth of stock in further recognition of his services. Whether this be so or not we cannot say. Our authority for it is only press reports.

It is our belief that there was no manager or engineer of a steel works in America whose heart was more completely in his work, or who was more vigilant and successful in acquiring every fragment of practical information as to iron and steel than was Capt. JONES.

Of his administrative abilities we need not speak. That he was so long and continuously the manager of works employing thousands of men says all that need be said on this head. He was distinctly one of those great "Captains of Industry" to whom ARTHUR HELPS justly claims so much honor is due as creators of modern civilization, and one of the foremost and most worthy.

Exposition Action.

The Executive Sub-Committee of the Finance Committee submitted a not too encouraging report Oct. 8, signed by J. PIERPONT MORGAN, AUGUST BELMONT, C. VANDERBILT, JOHN H. INMAN, SAMUEL D. BABCOCK, and J. EDWARD SIMMONS, stating that no positive financial plan could be submitted till the site question was settled. They say:

There are three sources from which the necessary funds for the establishment of the exhibition can be derived when the sum needed is ascertained, viz.:

First—Government and city aid (the State being prohibited by its Constitution from loaning or giving pecuniary assistance).

Second—The sale of bonds or other evidences of pecuniary interest in the enterprise.

Third—A preliminary fund with which to secure the inauguration of the work and to provide against the possibility of ultimate loss, and which should be represented by stock.

Obviously the amount to be obtained through the two last-named channels will depend upon the financial and other assistance to be derived from the General Government and the city. It is of first importance that Congress should give to the exhibition a national and an international character by appropriate legal enactment. It is also essential that the exhibition should receive encouragement and assistance from the State and the city of New York, and the suitableness and liberality of this assistance must be an important factor in any financial plan which may be adopted; for if direct money contributions are voted, or lands are set apart for the use of the exhibition, which belong to or may be acquired by the city, and upon which it may lawfully erect buildings, a very much less sum will be needed than if your committee must raise all the money or if private property must be leased or purchased. Of all the plans which have hitherto been submitted to the committee, none has appeared to us to supply means adequate to every purpose unless the necessary lands are provided by the city, free of expense to the exhibition.

When these uncertainties are removed, the committee cautiously remark that it will be "a comparatively easy matter to formulate a plan for obtaining popular subscriptions to the main fund," but they do not say to obtain all the money needed, and meanwhile

To show the sincerity and willingness of the citizens of New York, we recommend that steps be taken to raise a preliminary fund of $5,000,000, for which stock should be issued, as before stated, when authorized by Congressional or Legislative enactment, and that until $3,000,000 bona fida subscriptions have been made none of them shall be binding; and that books for this purpose be at once placed before the public, the fund to be at the disposal of the Finance Committee as soon as Congress has decided that the exhibition shall be held in New York, on the following terms and conditions, viz.:

First—The subscriptions to be paid in instalments of one-quarter of their total amount upon such calls as the Finance Committee may make, but not oftener than three months apart.

Second—The money thus obtained to be appropriated as the Finance Committee may direct, but not until Congress has decided that the exhibition shall be held in New York, and its location has been definitely settled.

Third—Any funds remaining at the end of the exhibition, after the closing of all accounts and the liquidation of all obligations, shall be divided pro rata among the subscribers to the fund or their heirs or legal assigns.

The full Committee on Site and Buildings held a meeting the same day lasting nearly three hours. The sub-committee to ascertain value of property required, Messrs. TOWNE, CHANDLER, and HUNT, returned in substance to their first love, using Central Park as a site, reporting in substance that the site should be ample for the construction of five buildings, to cover in the aggregate 65 acres, and 200 smaller buildings, to be scattered over an area not to exceed 250 acres. Such construction, of course, implied the use of land outside of the boundaries of the proposed site. The main site, the committee reported, could be at Riverside and Morningside Parks and on adjacent private lands, of which there might be needed only 120 acres, but that it could be better accommodated in 200 acres, making the total area of the site from 200 to 270 acres. From all the inquiries that the committee had been able to make,

the price of property in that section of the city was about $100,000 per acre, involving an outlay of $12,000,000 or $20,000,000, according to the choice of 120 or 200 acres. If all of this property had to be rented at 4 per cent. upon its valuation, the cost of rental would be $1,440,000 or $2,400,000, according to the choice of 120 or 200 acres.

The committee urged immediate and decisive action, and said that the managers of the Exposition at Paris were engaged 54 months in preparing for it. The committee had heard from but a small proportion of the property owners, and had become convinced that some better means must be devised of reaching the property owners than had yet been tried. The impression was that the only hope of securing the property lay in condemnation proceedings.

JUDGE HILTON, of malodorous memory in connection with the Stewart estate, thought Central Park should be taken without hesitation. Ex-Mayor COOPER thought it absurd to suppose that the city would buy $12,000,000 to $15,000,000 worth of land for the Exposition, and leaned toward using Central Park. Mr. GOMPERS thought the real sense of the committee was to use Central Park, and Mr. FLOWER thought enough should be used to keep neighboring property owners down in their demands. Mr. TOWNE adhered to his previously expressed conclusion that no building should be placed in the park, but the committee finally unanimously adopted the following resolution, explicitly including the north half of Central Park as part of the general grounds :

Resolved, That the proposed site, which includes Riverside and Morningside Parks, shall be held to comprise such portions of Central Park north of 97th street as are physically available and may be found absolutely necessary for the purpose of the Exposition, and also to include adjacent lands fronting on the north and east of Central Park, is in all respects the best; that therefore all efforts should be concentrated upon the acquisition of the needed area in this locality.

A report to the General Committee was then submitted, voted too long, and re-submitted next day. The General Committee met next day (Wednesday, Oct. 9) at 3 P. M.

The Thames River Bridge; New York, Providence & Boston R. R.

The railway bridge and draw by which the New York, Providence & Boston R. R. crosses the Thames River at New London, Conn., was officially opened to the public on Thursday of this week with fitting ceremony. This structure, which does away with the tedious ferry familiar to all travelers by this route, was discussed as long ago as 1859, when surveys were made; but work was indefinitely postponed, owing to the engineering difficulties arising from the great depth of water and an unknown depth of soft mud. Beyond periodical discussions of plans proposed, nothing more was done until January, 1882, when the present company was authorized by the Connecticut Legislature to bridge the river at this point, on a plan and location approved by the Secretaries of War and of the Navy.

In the summer following, the railroad company engaged Mr. ALFRED P. BOLLER, M. Am. Soc. C. E., as its engineer to solve the problem here presented, and in December of the same year received from Mr. BOLLER his report, the result of an elaborate study and thorough examination of the bridge site. This report was approved by a board of engineer experts acting in the interest of the corporation forming the Shore Line route, on March 28, 1883. In May, 1883, Congress passed an act authorizing construction, and the War and Navy Departments appointed a board, with Gen. JOHN NEWTON as chairman, to examine and report upon the proposed plan, which they finally approved.

Various circumstances delayed the actual inauguration of the work until the winter of 1888, when, through the persistent efforts of Mr. S. B. BABCOCK, the president of the company, Mr. G. M MILLER, vice-president, and Mr. J. W. MILLER, general manager, the engineer was instructed to push the work vigorously. As soon as plans could be prepared contracts were let, and by June, 1888, operations were commenced on the foundations.

The bridge itself crosses the Thames at its narrowest point. The entire superstructure is steel, and with its 503-ft. draw-span is the longest double-track drawbridge in the world, affording two clear passageways of 235 ft. for vessels. This draw is flanked on either side by two spans of 310 ft. each, and two other spans of 150 ft. each. The total length of the superstructure is thus 1,423 ft.

The foundation-work presented extreme difficulty in the unusual depth of 57 ft. of water at low tide, and in the heavy deposit of soft mud forming the river bed. As a result of these conditions, the three main piers penetrate water and mud to depths of 130, 128, 103 ft. respectively. Briefly described, the piers were founded on timber cribs settled 20 ft. into the mud, with the pockets in these cribs driven full of piles, some of the latter being originally 130 ft. long. The piles were sawed off 50 ft. below the surface, and open caissons carrying the masonry were then sunk upon them. The work was simple in design, but difficult and troublesome in the conditions under which it was executed.

The clear headway under the bridge is 32 ft. The draw, resting on steel wheels, is operated by steam-power, and automatic electric signaling devices connecting with the apparatus for locking the bridge insure the safety of trains. The weight of the draw is 2,600,000 lbs., and the bridge is proportioned for a moving load on each track of two 86 ton Consolidation engines followed by a train load of 2,000 lbs. per lineal foot.

Improvements at the Cornwall, Ont., Water-Works.

Various extensions have been made at the Cornwall, Ont., water-works this year. Owing to the building of a new lock near the point where the pipe line crosses the canal, a change in the original pipe line became necessary. This was effected, as we understand it, by the lowering of the 12-in. main already in place, while at the same time an additional 12-in. main was laid in the same trench. The two pipes were finally laid 4 ft. beneath the bottom of the canal, with their lower sides 9.4 ft. below the surface of the water, at the time of the laying, the water having been drawn down considerably. The 12-in. main already laid was supported on pairs of 6 x 6-in. timbers, laid across the trench by means of U bolts. The bolts first passed through washers or plates of wrought-iron, ⅝ x 4 x 18 ins., and had 8-in. threads on their upper ends to enable the workmen to keep the pipe in proper position while the frost thawed out of the banks.

Two concrete cut-off walls were built around the mains where they pass beneath the tow-path of the canal.

A coffer-dam was used to lay the pipe beneath the canal. It consisted of 2-in. elm sheet-piling driven around the outside of a frame of 6 x 6 in. hemlock. The frame was 3 ft. wide, and it was filled with puddled blue clay, taken from the bottom of the canal. The coffer-dam was 40 ft. wide, inside, and was used to lay about 130 ft. of pipe; it was first built for a portion of the distance only, then a part of one end removed to the other end.

About the time the pipe was laid beneath the canal the 16-in. suction pipe from the pumps to the river was replaced by two 10-in. suction pipes, one for each pump. A new inlet pipe was laid, and a change made in the delivery mains to the pumps, a cross-over connection to the new mains being substituted.

All of the above work was done without delay to the pumping. Mr. F. S. PECKE, Watertown, N. Y., was the engineer for the improvements, and we are indebted to him for the above data.

The Chicago Auditorium Building.

The copestone of this large new building was laid on Wednesday, Oct. 2, with Masonic ceremonies. The building has a frontage of 362 ft. on Congress St., 187 ft. on Michigan Ave., and 161 ft. on Wabash Ave., making the total area covered nearly 63,000 sq. ft. This is about the same area as that covered by the Equitable Building in this city, and about 9,000 sq. ft. more than that covered by the Metropolitan Opera House. On the Congress St. front a square tower rises to a height of 240 ft., 94 ft. above the roof of the main structure. This tower has six stories which are devoted to offices, and on its top will be established the Chicago station of the United States Signal Service. Electrical signals will be exhibited here for the guidance of lake navigators above the roof. The building proper may be said to be 10 stories high, the stories being interrupted in part by the auditorium.

The foundations to the tower cover an area of 69 x 100 ft., and were specially prepared to receive the weight of 15,000 tons, or about 4,350 lbs. per sq. ft., which was to be imposed upon it. The foundation was excavated to the clay layer on which all Chicago buildings are founded, and on this was built a timber grillage 2 ft. thick. On this, as a foundation, there was laid a layer of solid concrete 5 ft. thick, and to prevent any unequal settlement of this mass, and distribute the weight equally to all parts of the foundation, there were embedded in the concrete three layers of railway rails, one layer of 15-in. V beams, and one layer of 12-in. I beams. But even after these precautions, in view of the well-known compressibility of Chicago clay, it was feared that the great excess of pressure in the tower over that in other parts of the structure might carry the whole tower foundation down and cause cracks in the masonry at the points where the tower walls joined those of the main building. To guard against any possible defect of this sort, Messrs. ADLER & SULLIVAN, the architects, adopted the expedient of loading the tower foundation with a weight approximating to what it would have to carry when completed, which weight was gradually removed as the tower walls were carried up above the main structure. Thus far the expedient seems to have been entirely successful, and the tower shows no signs whatever of further settlement.

Among other noticeable feats of engineering accomplished in the structure were the carrying over the stage of four stories of rooms and two stories of iron rigging lofts. These are supported by four iron trusses, each having a clear span of 110 ft. The banqueting hall is carried over the auditorium room by two iron trusses, each of 120 ft. span.

Besides a great number of offices, the building will contain a hotel, with 400 rooms for guests, and the great auditorium, one of the largest public halls in the country, having a seating capacity of 5,000, which can be increased to 9,000 by throwing the stage into the hall and making extra provisions for the crowd. During the Republican National Convention a year ago there were 11,000 persons in the hall at one time.

The whole stage machinery is operated by hydraulic power, as are also the elevators in the portion of the building devoted to offices. There are 9 passenger and 4 freight elevators supplied from tanks on the fifteenth story of the tower, with a capacity of 28,000 galls. An artesian well, now down to 1,200 ft., will supply the hotel with water. The plumbing work throughout has been supplied with ventilating pipes leading to shafts up which the air is drawn by fans. The blowers provided for ventilating the hall and hotel have a capacity of 167,000 cu. ft. of air per minute.

To supply the auditorium with light, a set of six engines are provided, each connected to a dynamo. Their total capacity is 5,000 16 c. p., besides furnishing 115 H. P. for running electrical motors for various purposes. The hotel has five engines with dynamos, whose total capacity is 4,600 16c. p., and 140 electrical horse power for motors.

The company which has built and owns the building was organized in 1886. Ground was not broken, however, until January, 1887. The site of the structure cost $600,000 and is now estimated to be worth $1,000,000. The cost of construction of the building is set at $3,000,000, making the total investment about $4,000,000. The structure contains 15,000,000 brick and $350,000 worth of iron.

The President of the Auditorium Company is Mr. FERD. W. PECK. Mr. N. K. FAIRBANK is Vice-President. The architects of the building were Messrs. D. ADLER and L. H. SULLIVAN.

Nicaragua Canal Complications.

The complications between the Nicaraguan and Costa Rica Governments and the Maritime Canal Company, of Nicaragua, have grown so serious that it is said that the United States Government has determined to send the U. S. S. *Dolphin* to Nicaragua to protect the interests of the Americans who are engaged in the construction of the canal. The waterway, as surveyed, will touch upon the territory of Costa Rica, as explained more fully on our

editorial page. The company paid $100,000 cash and conveyed a block of stock to Costa Rica to settle any possible dispute. The Nicaraguan Government complains of this, and hints were made that the Canal Company should give a further compensation to Nicaragua. It is reported that a strong English syndicate is willing to give the Nicaraguan Government a consideration four or five times as large as that paid by the American company, and that managers of the canal company fear that English gold may induce Nicaragua to withdraw its concessions to the Americans. As yet, we attach little importance to this report.

Secretary BLAINE had a conference last Wednesday with HIRAM HITCHCOCK, President of the Canal Company, Chief Engineer A. G. MENOCAL, U. S. N., who has charge of the work of construction, and HORATIO GUZMAN, Nicaraguan Minister to the United States. It is said that at the conference, Secretary BLAINE declared that while he had no intention of interfering with the rights of any foreign nation, yet he was determined that those of the American company must be respected by both Nicaragua and Costa Rica.

The Ensilage Process.

On page 316 of last week's issue was a brief note regarding a new method of grain storage in which the inventor proposes to preserve the grain in tight bins for any length of time by simply surrounding the kernels with an atmosphere of carbonic acid gas. Reference was made to the fact that this process was based on the same principle as that used in the construction of the "silo." As some of our readers may never have had an acquaintance with "agricultural engineering," a few words as to what a "silo" is may not be amiss. According to all the ordinary processes of preserving fodder for use in the winter months, the grass or grain has to stand until near maturity, before cutting, at which stage much of its nutritious matter has been converted into useless woody fibre. In preserving fodder by the ensilage process, the plants are cut while they are still very green. Indian corn is generally preferred as giving the largest yield. A pit is excavated, 10 to 15 ft. deep, and walled and floored with concrete.

The green fodder brought in from the field is run through a cutter, which slices it into pieces about one-half inch in length; and it falls from the cutter into the pit, where it is trodden down and packed as closely as possible. When full a tight floor is laid on the top and a weight of several tons is placed upon it. The green fodder, filled with a great amount of saccharine sap, soon begins to ferment and gives off sufficient carbonic acid gas to expel all air from the pit. Being thus deprived of all atmospheric influence, the green fodder is preserved in almost the same state as when first placed in the pit, for an indefinite time. The process was first introduced into this country from France about fifteen years ago, and when correctly carried out has been very successful.

A Manual of Railway Field Work and Laying out of Works.

ACCORDING TO THE MOST RECENT AND APPROVED PRACTICE ON AMERICAN RAILWAYS.

BY A. M. WELLINGTON,
M. Am. Soc. C. E., M. Inst. C. E., etc.

[We begin with this issue the serial publication of those parts of this new work which appear likely to be of general interest and utility in advance of the publication of the complete work. The part relating to the use of transition curves by the author's method, which is believed to be far more useful than any of those now in print, in that it permits the ready use of any offset with any curve, will be given out of its order, in response to many requests; but that this method may be readily understood, it is necessary that Part I, as per following Table of Contents, should first be published.

In the work will be included numerous formulæ and methods never heretofore published for the expeditious and correct conduct of field work. It has been endeavored to give everything which is essential and nothing which is unessential to a thorough understanding of the principles and methods of instrumental field work, when conducted to insure final excellence in the simplest way, and with due subordination to economic considerations. The tables, while strictly limited to the requirements of good practice, will be an especial feature, modeled typographically on the best German models, and largely new.

The author invites typographical or other corrections, or suggestions as to form or substance, from any interested reader. All such will have full consideration.]

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CHAPTER I.—PRACTICAL PRELIMINARIES.

RAILWAY LOCATION is the art of laying down between any two points a line over which the locomotive can pass with ease and safety, and haul as many cars with as little wear and tear, and with as convenient access to possible sources of traffic, as topographical and financial difficulties will permit.

The difficulty and the importance of Railway Location as a branch of engineering practice arise not at all from the necessity of finding some possible line, which is always easy, nor of laying down the selected line upon the ground, but from the necessity of selecting from all possible lines that one which, on a balance of all considerations pro and con, gives the greatest economic value at the least cost for construction.

THE FIELD-WORK of RAILWAY LOCATION, or the "survey," has for its object to lay down the selected route upon the ground, to perfect its details, to determine its precise cost, and to prepare it for construction. In many cases, but by no means in all cases, much of the field-work is necessarily done before even a choice of routes can be made.

The field-work of railway location bears much the same relation to railway location proper, therefore, that the preparation of the working drawings of a house or a machine does to the determination of its character, proportion, and design. It is a comparatively simple art. An understanding of it is essential to the successful practice of the higher and more exacting branch of railway design yet no amount of practice or skill in it alone will suffice to qualify the engineer for the latter, or even go very far toward doing so. To become qualified for responsible charge of railway location, a variety of physical and financial problems, having no connection with the field-work of location, and not discussed in this volume, must first be studied.

ORDINARY SURVEYING has for its object to determine the area or form of certain parts of the earth's surface, or to lay out certain areas or geometric forms upon it. Geometric accuracy, therefore, is the end in view. In proportion as the survey is made more precise at a given cost, it is made better; the less its precision, the less its value.

RAILWAY SURVEYING has no such object. Geometric accuracy is for it of no importance as an end, but only as a means to an end. In so far as such accuracy tends to promote the smooth passage of the locomotive and other ends specified in § 1 it is important; in so far as it does not tend to promote those ends, it is unimportant; in so far as it may tend to obstruct or impede those ends, it is detrimental.

As a result of these conditions, many of the details of railway location are not conducted, in the best practice, with that attention to geometric precision which would be customary and proper in ordinary surveying work for much less important ends; for the reason that a bad location is not made better by being instrumentally precise, while the time and attention of the engineer are diverted from more important ends, and even the attainment of those ends is impeded, by over-attention to what are in railway surveys mere unessential details.

Nevertheless, it fortunately happens that a high degree of geometric accuracy is not only readily attainable, but is a great assistance toward the attainment of the true end of the survey, namely, to adapt the details of the line in the best possible way to the topographical conditions.

Moreover, to obtain a clear understanding of the degree of accuracy to be sought, and how best to secure it with the least labor, it is essential that the student be trained, or train himself, in habits of extreme precision, that he may understand the conditions on which it depends, the difficulty of securing it, and the comparative sacrifice of deviating from the methods of absolute precision to save time and labor.

As illustrating the distinction between good work and precise work which it has been attempted to outline, and which bears with it important consequences, it is easily possible to make an admirable location survey with no other instruments of precision than a level and chain. That surveys are not so made, but with a transit, is because it is more economical and convenient, and in no sense that a better grade of railway location is thereby made possible; although, in ordinary surveying, instruments of angular and linear precision are indispensable to the attainment of any reasonable grade of excellence.

By whatever means a railway may be located, the final dependence for the maintenance of linear accuracy in the rails is upon the eye alone, and it is a most imperfect reliance. This may be shown in an instructive and striking way by setting up a transit instrument to sight along the rails of any piece of track, however good. The rails will be found to be full of what appear to be—and in fact are—short, sharp kinks of an inch or so lateral deviation, while if there were any means by which a ray of light could be made to follow the arc of a circle, the lateral deviations on even the best-maintained old track would be vastly more noticeable.

These deviations from exact alignment are objectionable, because so quick and sharp, but they are not practically remediable. The similar small deviations which would come by doing all the linear work of laying out the road bed by the aid of the eye alone would not be objectionable, because they would disappear in laying the track, whereas the larger deviations of perhaps a foot or two in a mile from an exact right line would be in no way practically injurious to the motion of trains, but might rather be beneficial, for it is quite certain that a 1° to 5° curve, or say 13 to 65 miles radius, will give a smoother motion to trains, and cause less wear and tear, than an exact straight line, because of its steadying effect on trains. (Ec. Th. Ry. Loc. § ———) Only the practical difficulty of keeping such almost imperceptible curves in good alignment, and

of laying them out correctly, prevents their being used in all good location in preference to tangents. But a 1° curve means a deviation of about 0.8 ft. in a mile from an exact straight line.

Again, however accurately the line be run in for construction to sub-grade (the top of the grading on which the ballast, ties, and rails are placed), it is rarely found practicable or convenient to precisely follow this line in running track centers. Embankments or excavations are a little out of line, from sliding or from projecting rock points or otherwise, structures have been placed from necessity or otherwise in a slightly different position from what intended, the chaining is always less accurate than after the road is graded; so that not infrequently old alignment notes are abandoned altogether, and a new center line located to fit the roadbed as constructed, which it is found can be done more rapidly than to attempt to correct the old line.

But while great geometric precision is not essential, nor even important for its own sake, the more definite and precise instrumental methods are economical of both time and money and practically result in a better grade of work. It is therefore the universal rule, in good practice, to lay out the final line with a high degree of instrumental precision, so that it can be recovered with certainty at any time and at any point within less than an inch laterally. The convenience of having the line thus precisely defined is great, while the additional trouble is so small as to make inexcusable a failure in this respect. But the reason why it is done should be clearly understood because it is indirectly convenient, and costs nothing but care and a proper understanding of the work, not that such precision is in itself important, as it is in ordinary surveying.

In making railway surveys the line is laid off in *stations* of 100 ft., by a chain of that length. These stations are numbered consecutively from 1 on. At the end of each station a *station stake* is set, 20 to 24 ins. in length and marked with the number of the station, the number always facing toward the beginning of the survey. Any intermediate point is designated as a *plus*; thus 17 + 60 designates the point 60 ft. beyond Station 17 in the direction of Station 18.

It is a better practice, in setting station stakes, to drive a short peg, of perhaps 6 or 8 in. length, flush with the ground at the station point, and set the station stake just in front of it. The peg serves the double purpose of giving an exact point for the level rod to be set on, and of permanently making the station, in case the larger stake is lost or removed, as it very frequently is.

The "station," properly speaking, is the entire distance between the station stake and the last preceding. The term is also used, however, and without any serious confusion, to designate merely the point marked by the stake, at which the station terminates.

Long stations or *short stations* are those which exceed or fall short of the regular length of 100 ft. They are to be avoided if conveniently possible, but are frequently necessary in making readjustments of line, and too much time should not be spent in taking them out by re-stationing. They should, however, be taken out of the curves, and thrown into the tangents.

When a revision causes a greater difference of length than 100 ft., or when two entirely distinct lines of survey are connected, no attempt is made to give continuous stationing, but the intersection is noted thus: 100 + 60 = 518 + 35. The distance between Stake 100 and Stake 518 will then be either 95 ft. or 25 ft., according as the two lines run in the same or in opposite directions.

The points on which the transit instrument is set up in running the line are called *transit-points*, or more briefly, *plugs*. They are short, thick stakes about 15 ins. long, driven nearly but not quite down to the natural surface, with the line accurately marked on them by a small nail. The nail also should not be driven quite down to the surface, as the wood is then apt to swell up around it and cover it. A *witness stake* or *guard stake* is set about a foot to the right of the plug, with the marked face toward it.

(TO BE CONTINUED.)

THE ST. LOUIS ELEVATED RAILWAY is said to be assured by the successful negotiation of a loan of $6,000,000 in New York.

Luminous Paint.

Until now the commercial manufacture of luminous paint has been confined to England, where a single factory turns out a small supply at a price of about $3 a pound. This enormous cost seems to have prevented the use of the paint except as a curiosity, but a firm named Mahren, at Triesch, in Austria, has found means to produce it and place it on the market at 50 cts. a pound, or about one-sixth of the English price. Even at 50 cts. a pound, a substance composed of roasted oyster shells and sulphur might, one would suppose, be manufactured at a good profit, but at that price it is likely to come into extensive use. Wherever it can absorb light during the day, it will give it forth at night, and it is said that a railway car in England, which has had its ceiling painted with it, was so brilliantly illuminated that one could see to read a newspaper in it during the darkest night, without other light. With all due allowance for the enthusiasm of early experimenters, there is no doubt that cars with ceilings so painted would be pleasant to ride in, whether one could really see to read in them at night or not; and for making keyholes, stairways, and sign-boards luminous, the paint would have advantages which have been surprisingly little utilized. Its application to stairways is a particular obvious one, and the Austrian manufacturers furnish a kind of wall paper on which the paint can be used to better advantage than on the bare plastering. The paper, which is of a leathery texture, is first treated with lime-water, and then primed with a composition furnished by the same firm. After this is dry, two thin coats of the luminous paint are applied, and the whole may then be varnished.

A REPORT UPON IRRIGATION IN CASSIA CO., IDAHO, has been made to Gov. STRANGVAN by T. A. STARRH. There are in this country 281 irrigating ditches, having a total length of 373 miles, and irrigating 28,600 acres, or about 40 sq. miles. The total area of the county is 5,100 sq. miles, about a fourth of which, or 1,200 sq. miles, is said to be good farming land when irrigated. It will be seen from the above that about 3⅓ per cent. of the arable land within the county is under irrigation. All the water of many of the streams is now used, excepting in January, February, March, and April, when much runs to waste. Mr. STARRH estimates that the expenditure of so small a sum of money as $100,000 in the construction of storage reservoirs would reclaim 60,000 acres of land that cannot be reached in any other way. In addition, such reservoirs would furnish water to 5,000 acres already settled, but which must otherwise be abandoned for lack of water. The elevations given in the report were corrected by Mr. FRANK RIBLETT.

THE autumn term of the classes at the Young Men's Christian Institute, 222 Bowery, New York City, began on Monday, Sept. 30. A circular is issued showing the different branches in which instruction is given, and the facilities offered by the Institute. For circulars or other information address Mr. E. C. BALDWIN, Acting Secretary.

RAILWAYS.

EAST OF CHICAGO.—Existing Roads.

New York, Ontario & Western.—The Ontario, Carbondale & Scranton R. R. Co., formed by the consolidation of the Hancock & Pennsylvania, the Forest City & State Line, and the Scranton & Forest City railway companies, has been incorporated in Pennsylvania. The road runs from Hancock, N. Y. to Scranton, Pa. Among the directors are: EDWARD B. STURGES, WM. H. RICHMOND, DANIEL SCURRY, EDWARD CLARKSON, JOHN BURTON and JOHN B. KERR.

Brantford, Waterloo & Lake Erie.—Tracklaying on this Canadian road is now completed as far as Mt. Pleasant, Ont.

Kinderhook & Hudson.—Construction has been commenced on this road, which is projected to run from Hudson to Kinderhook, N. Y., 16¼ miles. E. G. FERRIS, of Hudson, is Chief Engineer.

Toledo, Ann Arbor & North Michigan.—It is expected that the extension from Cadillac to Manistee, Mich., will be opened for traffic by Nov. 1.

Michigan Central.— This company will do considerable double tracking work this season. Work will immediately be commenced between Grass Lake and Dexter, Mich. The grading will be done this fall and the rails laid early next spring. This will leave only 18 miles of single track between Detroit and Chicago. The last link, between Dexter and Ypsilanti, will be done as soon as possible. An important and expensive work will also be undertaken between Jackson and Niles on the loop line. All the grades in that distance will be reduced so low that none will exceed 20 ft. to the mile. The new track will all be laid with the Michigan Central standard rail, with 44-in. angle bars.

Western Counties.— The grading on this line from Digby to Annapolis, N. S., about 25 miles, is nearly completed.

Utica & Unadilla Valley.—This company, which has been having considerable trouble with stockholders who refused to pay their subscriptions, has, it is stated, made arrangements whereby the construction of the road will go on and the road be rapidly pushed to completion. The road is to run from Bridgewater to New Berlin, N. Y., 20 miles. Tracklaying is now in progress. DELOS E. CULVER, of Bridgewater, N. Y., is Chief Engineer.

Delaware, Lackawanna & Western.—This company will build a short branch into Paterson, N. J., and erect a large depot at the corner of Slater St. and Dale Av. It is stated that the contract has been let and that the work is to be completed within 6 months.

Baltimore & Ohio.—Chief Engineer DOUGLAS, who has just finished inspecting the Shenandoah Valley branch, recommends an extension from Lexington, Va., to Salem or Roanoke, Va., to obtain southern connections with the Virginia roads, which will probably contribute a large amount of traffic within a few years.

New York Central & Hudson River.— A press dispatch from Louisville, Ky., states that a number of gentlemen backed by this company have purchased all of the property situated on Main St., of that city, between Brooke and Hancock Sts., and will build a depot and other terminal facilities thereon. It is also stated that the proposed Louisville, Cincinnati & Dayton R. R., now being surveyed between Louisville Ky., and Cincinnati, O., will become the property of the same company.

Indiana & Lake Michigan.— The contractors who are building the extension from South Bend, Ind., to St. Joseph, Mich., 40 miles, state that the road will be in shape to run trains over in 60 days.

Central R. R. of New Jersey.—It is stated that this company will build a branch from Perth Amboy to Woodbridge, N. J., to parallel the Woodbridge & Perth Amboy R. R. The object is to obtain an independent line to the Woodbridge factories.

Brigantine Beach.—M. H. POLK, of 435 Chestnut St., Philadelphia, Pa., sends us the following:

The road is to run from Pomona Station through Oceanville to Brigantine Beach, N. J., a distance of 12.8 miles. The surveys for the road are nearly completed. The maximum grade is three-fourths of one per cent., and maximum curve 3°. About 6 miles of the route is through a scrub oak and pine region, 5 miles through meadow land, and the remainder pile trestle. The longest trestle is 6,500 ft. All the right of way has been obtained. The contract for building the road has been let to J. W. Coffin & Co., 35 Broadway, New York. It is expected that tracklaying will begin about Oct. 14, and the road be opened for traffic, July 1, 1890. SAMUEL ST. JOHN MCCUTCHEN, is President, and EDMUND C. STOUT, of the firm of Hill & Stout, Civil Engineers, 42 Broadway, New York, is Chief Engineer. The address of the Chief Engineer, is Oceanville, N. J., for the present.

Mount Penn Gravity.—A correspondent has furnished us with the following data concerning this enterprise:

The road runs from the terminus of the Perkiomen branch of the Reading City Passenger railway 2¼ miles to the top of Mount Penn, and then by gravity, 6½ miles, to the starting point. The work is heavy; a large amount of curvature; grades 5 and 6 per cent. The total rise is 650 ft. The road is built to do only a passenger traffic during the summer months. The road is now completed to the summit, 2¼ miles. About 200 men are now at work on the line. The line will be opened for traffic in May 1890.

Canadian Pacific.—The Detroit extension of the Ontario & Quebec R. R. is now ballasted as far west as the crossing of the Grand Trunk Ry., 5 miles west of Chatham, Ont. Eastward the track is laid as far as Louisville, 72-lb. steel rails are being used with 9 ft. ties and 42 in. angle bars. The line will be completed by Dec. 1.

Grand Trunk.—Surveys are being made for a second track between Hamilton and Toronto, Ont.

Wheeling & Lake Erie.— It is stated that this company will abandon its proposed line from Bowerstown to Steubenville and build directly from Bowerstown to Wheeling, W. Va.

American Midland.—A report is in circulation that ANDREW CARNEGIE has completed arrangements by which he will secure possession of this road. The road is now completed and in operation from Findlay to Glendorf, O., 23 miles, and is graded west from Glendorf to Fort Wayne, Ind.

Projects and Surveys.

Kennebec Central.—This company, which proposes to build a railway from Augusta to Togus, Me., has been organized with the following officers: President, WESTON LEWIS; Treasurer, P. H. WINSLOW; Clerk, H. S. WEBSTER, and Auditor, A. C. STEPHEN. Contracts for building the road will be let soon and the road pushed rapidly to completion.

Neversink Valley.—We have received the following information from JOHN W. LOW, of Middletown, N. Y., Vice-President:

The preliminary survey has been completed for this road, which is projected to run through the towns of Fallsburg, Woodbourne, Hasbrouck and Neversink, all in Sullivan county, N. Y., a distance of about 11 miles. The road runs through a fine agricuitural country and it is expected it will have a large business in farm produce and summer travel. The maximum grade is about 40 ft. per mile. There will be one bridge across the Neversink River. About 6 miles of the right of way has been secured and $10,000 of local aid obtained. The contracts will probably be let next Spring to Drake & Stratton, 71 Broadway, New York. WM. B. ROYCE, of Middletown, is President, and G. T. RICHARDS, of Pittsburg, Pa., is Chief Engineer.

Montrose & Binghamton.—H. F. BEARDSLEY, Secretary of Board of Trade, Montrose, Pa., writes us that the only steps which have been taken toward the construction of this railway are to have surveys made from Montrose to various points. He states that there is no immediate prospect of a line being built from Montrose to Binghamton, N. Y. A charter has been granted for a road to run from Montrose to a connection with a Delaware, Lackawanna & Western R. R. at Montrose Station. The road is to be called the Lackawanna & Montrose R. R. A proposition has also been made to extend the Montrose Narrow Gauge R. R. to Halistead.

Little Falls, Van Hornesville & Richfield Springs.—S. E. BABCOCK, of Little Falls, N. Y., Chief Engineer, has given us the following information:

This road is projected to run from Little Falls, via Newville, Van Hornesville and Springfield to Richfield Springs, N. Y., a distance of 27 miles. The maximum grade is 105 ft. per mile; curves very light. The route is through a fine farming country and the road will do a large business in farm produce, but the principal source of traffic will be the transportation of coal to the Little Falls market.

Waldo & Somerset. — This proposed railway is to run from Burnham Junction on the Maine Central R. R., to the village of Canaan, Somerset county, a distance of 8 miles. The charter was granted about 3 years ago and the following directors elected: V. R. TUTTLE, President; JOHN TUTTLE, JOHN DREW, BENJ. CHASE, JAS. HARMON, A. GOODRICH, M. H. FURBER, AMOS STEVENS, and B. BURRILL, all of Canaan. Chief Engineer HENRY A. HANCOX, of Hudson, Mass., has already commenced the locating surveys for the line. As there was a time limitation for starting construction in the charter, which expires Dec, 31, 1889, it is proposed to begin construction at once.

George's Valley.—This road is projected to run from Warren Station on the Knox & Lincoln R. R., through South Union to Union Common, a distance of 8 miles. The town of Union will be the terminus for the present, but the line will eventually be extended up the George's River valley through the towns of Appleton, Searsmount and Belmont to Belfast, where it will connect with the Maine Central R. R. The route is through some of the finest farming country in the State, and will afford an outlet to the extensive lime-stone quarries just being developed along the line. The Chief Engineer, HENRY A. HANCOX, of Hudson, Mass., has just completed the surveys for the line; and as soon as the maps and profiles can be prepared, contracts will be let.

Maine.—J. B. PEAKS, of Dover, will receive bids for the construction of a 16 mile railway.

Wheeling & Connellsville.—A dispatch from Wheeling, W. Va., states that the syndicate of Boston and New York capitalists, which is building the Union Railroad Bridge at that place, have in contemplation the construction of a railway from Wheeling to Connellsville, Pa.

Lackawanna & Southwestern.—Articles of consolidation of the Lackawanna & Southwestern and the Rochester, Hornellsville & Lackawanna railway companies have been filed with the Secretary of New York State.

Marquette, Champion & Chicago.—The Railroad Board has approved the route of this projected Michigan road.

SOUTHERN.—Existing Roads.

South Carolina.—An order has been filed in the United Circuit Court at Charleston, S. C., appointing DANIEL H. CHAMBERLAIN, of New York, temporary receiver of this road until a permanent receiver can be appointed. The receiver was appointed on the complaint of FREDERICK W. BOUND, of Montclair, N. J. The complaint alleges, in general terms, that the complainant is the holder of unpaid second mortgage bonds and coupons. That the road has defaulted both on its first and second mortgage bonds and coupons for over a year, that its indebtedness is over $9,738,000 and is hopelessly insolvent, that suits are about to be brought against the road, and that the company has been applying its income to the payment of its floating debt instead of to its mortgage debt, and that the road has been badly managed and is steadily detoriating.

Seaboard Air Line.—It is stated that this company has an engineer looking over the route for an extension from Greensboro to Ridgeway, N. C., a distance of about 85 miles.

Eutawville.—Good progress is being made on this South Carolina road. Work is now in progress from Summerton on the south and Sumter on the north. Grading is being pushed, and tracklaying is following as close behind as possible. Tracklaying is now completed from Sumter to the Pocotaligo swamp. All the piling over the trestle across the swamp is finished, and the structure will be ready for the rails in a short time. Work on the Santee trestle is being pushed forward rapidly, and will soon be completed. It is stated that as soon as the line has been completed to Sumter work will begin on an extension to Cheraw.

Louisville & Nashville.—The annual report of this company for the year ending June 30, 1889, shows the following results:

Gross earnings	$16,599,396
Operating expenses	10,326,085
Net earnings	6,273,311

During the year the company expended $1,382,365 for improvements. The company is now building an extension of the Cumberland Valley branch to Norton, Va., where connection will be made with the Norfolk & Western R. R. The directors have also authorized the building of a branch from Helena, Ala., into the Cahaba coal fields. The issue of $13,000,000 of new stock was confirmed by the stockholders.

Farmville & Powhatan.—The deed conveying the Brighthope Railway to this company has been filed, and that road will be operated as a portion of the Farmville & Powhatan R. R. Tracklaying has been completed to Belona, Va., the grading from Belona to Farmville is completed, and the bridge across the Appomattox River near Farmville is nearly completed. The road is to run from Bermuda Hundred to Farmville, Va., 92 miles.

Alabama Midland.—Terminal facilities have been secured at Tuscaloosa, Ala., and surveyors are now at work on the line from Montgomery to Tuscaloosa. Grading is now in progress between Ramer and Ozark, Ala., 68 miles.

Wilmington, Onslow & East Carolina.—This road has been graded from Wilmington to Scott's Hill, 12 miles, and tracklaying is now in progress. The road is projected to run from Wilmington to Jacksonville, N. C., 48 miles. RICHARD LAMB, 1 Broadway, New York, is at the head of the enterprise.

Winifrede.— It is stated that this West Virginia road will build a branch from near Racine, W. Va., to Marsh Fork of Coal River, 15 miles.

Lynchburg & Durham.—This road has now been completed from Lynchburg to the Staunton River, 39 miles.

Florida Central & Peninsular.—A press dispatch states that a line will be built by this company from Plant City to Tampa, Fla.

Decatur, Chesapeake & New Orleans. — This road has been completed from Moore County, Tenn., to the Alabama State line, 34 miles. About 16 miles of track have also been laid on other portions of the line. The company will, it is stated, soon let contracts for 100 miles more of the road.

Green Pond, Walterboro & Branchville.—This road, running from a point on the Savannah, Florida & Western R. R. to Branchville, S. C., 15 miles, has been purchased by the Plant Railway syndicate.

Projects and Surveys.

Bowling Green & Northern.—M. H. CRUMP, of Bowling Green, Ky., Secretary, sends us the following:

The Bowling Green & Northern Railway is projected to run from Bowling Green, to a point on the Chesapeake, Ohio & Southwestern R. R., between Litchfield and Grayson Springs Station, a distance of about 50 miles. The first 20 miles will be very heavy work, there being 2 bridges 300 ft. each, and a tunnel 1,800 ft. long. The route is through a fine mineral and timber region, and it is thought that the road will have a large business in coal, iron, lumber, asphalt, sandstone, and building stone. The surveys for the line are completed, and the contracts for construction will be let within 30 days. The road must be completed by March, 1891. Capt. H. SAWYER was the engineer in charge of surveys.

Augusta & West Florida.—C. E. SMITH, 3 Warren Block, Augusta, Ga., President, has given us the following data:

The surveys for this road which is to run from Augusta, via Wadley, Dublin, Eastman, Abbeville, Irwinville, Tifton, and Moultrie, to Thomasville, Ga., a distance of about 230 miles, have been commenced, and about 50 miles of the preliminary survey completed. There will be two large bridges over the Oconee and Ocmulgee Rivers. The route is through some of the finest timber and farming lands in the State, and it is believed that the road will have a large business in timber, melons, vegetables, cotton, and fertilizers. Work at securing the right of way will commence at once.

Johnson City & Carolinas.—This company, which proposes to build a railway from Johnson City to Embreeville, Tenn., has organized with the following officers: Col. E. C. REEVES, President, H. H. CARR, Secretary, and T. E. MATSON, Treasurer. Preliminary surveys are in progress.

Camden, Chester & Gaffney.—Preliminary surveys are in progress for this road, which is projected to run from Gaffney to Camden, S. C., 85 miles. J. V. SARRATT, of Chester, S. C., is President.

Boyce & Tennessee River.—It is stated that a railway is to be built from Boyce, Tenn., to the Tennessee River, about one mile. DWIGHT MONTAGUE, of Chattanooga, Tenn., is interested.

Georgia.—The following bills have passed the Georgia State Legislature: To incorporate the Ocean Pond & St. Mary's Short Line and Dahlonega & Dawsonville railway companies; also an act to amend an act to incorporate the Way Cross Air Line R. R. Co. The following bills passed the Senate: to incorporate the Kansas City, Chattanooga & Port Royal R. R. Co., and the Rome, Subligna & Northern R. R. Co. The House also passed onthird reading bills to amend the charter of the Albany & Bainbridge R. R. Co., to amend the charter of the North & South Short Line R. R. Co., and to incorporate the Albany & Cordele R. R. Co.

NORTHWEST.—Existing Roads.

Sioux City & Northern.—Tracklaying has been commenced at Palisades, Dak., and is now progressing at the rate of two miles per day. The grading and surfacing is about 15 miles ahead of the tracklaying, and it is thought that the entire line will be completed by Nov. 30. 60-lb. steel rail is being used.

St. Paul, Minneapolis & Manitoba.—President JAMES J. HILL has issued a circular to the stockholders of this company explaining the proposed issue of stock and plan of reorganization of the company, which has been adopted. The Great Northern Railway Co. has been organized with a capital stock of $40,000,000, of which one-half will be preferred stock entitled to dividends in preference to all other stock, at a rate of 6 per cent. per annum. This preferred stock is to be issued at par; but the stockholders of the Manitoba Company will be required to pay only $50 in cash, the other $50 being secured on assets of the old company amounting to about $22,000,000. The new company will lease all property now controlled by the Manitoba Company for a term of 99 years, paying dividends as above in quarterly instalments, also all taxes, interest, and current liabilities, and guaranteeing all obligations of the Manitoba Company and indemnifying it against all liabilities.

Pacific Short Line.—The bridging on this line has been completed between Sioux City, Ia., and Plainview, Neb., and it is announced that tracklaying will soon begin.

Canadian Pacific. — The graders on the Brandon-Souris branch, have reached a point 39 miles south of Brandon, Man.

Northern Pacific & Manitoba.—It is stated that this company will begin work soon on the extension to Lake Manitoba, and will next season put a steamer on the lake.

St. Louis & Chicago.—This road, running from Springfield to Mt. Olive, Ill., 53 miles, has been sold at foreclosure to A. H. JOPLIN, of New York, representing the second-mortgage bondholders. A reorganization committee has been formed, and the road will be placed under a new management.—The St. Louis & Peoria R. R. running from Mt. Olive to Alhambra, Ill., 14 miles, has been completed and opened for traffic.

Duluth Incline.—The incline portion of this railway at Duluth, Minn., has been completed. The incline is 7,300 ft. long with a rise of 600 ft. The road will be continued west to the Cloquet River immediately, and ultimately to the lumber district. From the foot of the incline, the road has been completed 1½ miles to West Duluth.

Projects and Surveys.

Black Hills Central.—The survey of this road has been completed from Floral Valley, Wyo., to Rapid City, Dak.

Niobrara & Sioux Reservation. — Incorporated in Nebraska to build a railway from a point in town 27, range 5, in Antelope County, through Antelope and Knox Counties, to the State line. Among the incorporators are: F. P. BONNELL, CHAS. H. SWIGGET, and J. A. KISTERSON.

Canada.—The following, taken from a dispatch to the *New York Tribune* gives the statement made by D. A. ROSS, Acting Minister of Public Works of the Province of Quebec, concerning a new railway from the west to the Atlantic seaboard:

Some wealthy Minneapolis mill owners have found that the transit of their goods is entirely in the hands of Boston and New York lines, and that they are losing thousand of dollars thereby. They are therefore desirous of building a line from Minneapolis to the Sault, giving a new and independent route. In connection with this they are asking the Quebec government for a charter to construct a line from somewhere about Calumet, a point between Ottawa and Montreal, on the north shore of the Ottawa River, on the Canadian Pacific main line to a point 40 miles back of the Canadian Pacific road, and thence on to Quebec City and through Gaspé to the very end of the peninsula, where they will construct docks and create a new port on the Atlantic all the year round. They have plenty of money and do not ask us for a single cent; merely a grant of land. The grant they apply for is more than we are willing to concede, but negotiations are going on, and the line would be so important that we shall, if possible, meet them. The rivers on the route proposed are easily bridged.

SOUTHWEST.—Existing Roads.

Cleveland, St. Louis & Kansas City.—Work will soon be resumed on this Missouri road. The contract has been let to the Missouri River Construction Co. The track between St. Charles and Matsen's, 6 miles, will be laid first, and as soon as the rails can be obtained tracklaying will commence between St. Louis and Alton. Rails for the first six miles have been purchased from

Carnegie & Co. Work will also be resumed on the bridge at Alton soon.

Mississippi River & Bonne Terre.—This road is now completed to Crystal City, Mo. Only five miles of track now remain to be laid to complete the road to a connection with the St. Louis, Iron Mt. & Southern R. R.

Hutchinson & Southwestern.—Articles of consolidation of the McPherson, Texas & Gulf and the Hutchinson, Oklahoma & Gulf railway companies have been filed with the Secretary of State at Topeka, Kan. The road is now completed from Hutchinson to Kingman, Kan., 30 miles, and it is intended to push the construction to Oklahoma at once.

New Orleans, Ft. Jackson & Grand Isle.—About 14 miles of the grading has been completed, and tracklaying is to begin in a few days. CHAS. S. DWIGHT, 25 Carondelet St., New Orleans, is Chief Engineer.

Atchison, Topeka & Santa Fé.—The new reorganization plan of this company comprises the issue of a large blanket mortgage at a low rate of interest retiring all the present mortgage bonds. The plan is similar to that adopted by the Chicago, Milwaukee & St. Paul Ry. Co. and proposed by the Northern Pacific Ry. Co.

Projects and Surveys.

Shreveport, Red River & Mississippi Valley.—This company has been organized to build a railway from Shreveport, La., to Natchez, Miss. P. J. FREZEVANT is interested.

Brazos & Kansas City.—This company has been organized to build a railway from Brazos, Tex., via Waco and Ft. Worth, Tex., to Kansas City, Mo., about 780 miles.

Cape Girardeau & Sikeston.—A project is on foot to build a railway from Cape Girardeau to Sikeston, Mo. LOUIS HOUCK, of Cape Girardeau, has offered to build the road before Jan. 1, 1891.

Arkansas & Gulf.—This company, which was chartered some time ago to build a railway from a point in Chicot County, Ark., to a point on the Kansas City, Fort Scott & Memphis R. R., in Fulton County, Ark., a distance of about 275 miles, is now securing right of way for the road with the intention of beginning construct on in the spring.

ROCKY MT. AND PACIFIC.—Existing Roads.

Astoria & South Coast.—The surveys have been completed from Astoria, Ore., to Jewell, a distance of 42 miles, and 18 miles of this distance graded. A large amount of rails is on hand, and as soon as a locomotive can be obtained, tracklaying will begin and be pushed rapidly to completion.

Union Pacific.—General Manager C. J. SMITH, of the Oregon Railway & Navigation Co. is reported as saying that engineers are now running lines for an extension of the Union Pacific Railway from Portland, Ore., to Puget Sound, and that such a line would be built in the near future. The line would parallel the Northern Pacific Railway the entire distance.

Vancouver, Klickitat & Yakima.—Surveyors are reported at work on this line, which is to run from Vancouver, W. T., through Klickitat Pass, about 180 miles. R. A. HABERSHAM, of Vancouver, is Chief Engineer.

Denver & Rio Grande.—About 300 men are now at work on the Manitou & Pike's Peak R. R. B. Lantry & Son, of Denver, have the contract.

Seattle, Lake Shore & Eastern.—Siver & Co., who have the contract for building the short extension from the present terminus of this road to Davenport, W. T., are pushing work. They expect to have the line in operation by Oct. 15.

New Westminster & Southern.—Grading is being pushed on this British Columbia road. The road is now being graded from New Westminster, B. C., through the serpentine flats, and between the Frazer River and the Nachomeckl, within 6 miles of Blaine. Three preliminary surveys from the present grading, via Blaine and Ferndale, have been made to Whatcom, W. T.

Projects and Surveys.

Little Book Cliff.—W. T. CARPENTER, of Grand Junction, Col., President, sends us the following:

The surveys are nearly completed for this road, which is to run from Grand Junction northeast to the Book Cliff, a distance of about 11 miles. The maximums grade is 5 per cent. and maximum curve 30°. The principal business of the road will be in coal, building stone, and the mountain passenger traffic. The contracts for construction will be let Oct. 7, 1889. E. B SAWYER, of Montrose, Col., is Chief Engineer.

Great Falls & Canada.—Incorporated in Montana to build a line of railway from Great Falls to the Canadian line and thence to Leithbridge. The object of the road is to open up the coal fields at Leithbridge.

FOREIGN.

Guatemala.—The Champerico & Ritoibeulen railway has been purchased by capitalists of Champerico, who will extend the line to San Felipe or Contra Costa.

Interoceanic.—This road has been opened for traffic between the city of Mexico and Perote, and the Morelos line has been completed to Tialtizapan. Work is being pushed on the division between Perote and Jalapa.

Matamoros & Mateuhala.—A concession has been granted by the Mexican Government for a railway to run from Matamoros, via Linares, to Mateuhala. Work is to commence 1 year from the date of the charter, Aug. 29, 1889, and the first section from Matamoros to Linares is to be completed in 5 years, and the second section to be completed within the succeeding 7 years. The Government has subsidized the road to the amount of $8,000 per kilometer. The road reverts to the Government after 30 years. The line will open up a rich mineral and agricultural country.

Mexican Central.—This company has completed 225 kilos. of track on the Tampico-San Luis line at the Tampico end and about 40 kilos. at the San Luis end. It is now pushing work on the remainder of the line and it is thought that the road will be completed soon.

RAPID TRANSIT.

Street Railways.—*Lewiston, Me.*—The Lewiston & Auburn St. Ry. Co. will build an extension.

Brooklyn, N. Y.—The franchise for a line on Montague St. will be offered for sale again, the Montague St. Ry. Co. having failed to file its bond.——The Brooklyn City Ry. Co. has been granted a franchise for an extension of its Flushing Ave. line, and will pay the city 1-10 of 1 per. cent. of the gross receipts.

Utica, N. Y.—Two naphtha gas motors, on the Connelly system, are to be tried.

Ocala, Fla.—The Ocala & Suburban Ry. Co. has been granted a new charter and has put up a bond to commence work at once.

Waukesha, Wis.—A street railway franchise has been granted to Fetch & Jarvin, of Louisville, Ky.

Waterloo, Ia.—A franchise for a street railway between Waterloo and Cedar Falls has been granted by the supervisors of Black Hawk County.

Junction City, Kan.—The Junction City & Fort Riley Rapid Transit St. Ry. Co. has been incorporated by JOHN K. WRIGHT, W. W. COOK, and C. L. LINTON of Junction City, and others. Capital stock, $50,000.

Lindsborg, Kan.—A proposition has been made to build a street railway and put in electric lights and water-works.

San Francisco, Cal.—The Omnibus Co. is building a double-track line, 3 miles long, to the Potrero, at a cost of $12,000 per mile. It will be operated by horses until the traffic warrants its conversion into a cable road.

St. Thomas, Ont.—The only bid for the street railway, which was sold at auction recently, was $1,000 from Mr. LINDOP. This bid was rejected, being below the reserve price.

Electric Railways.—*Amsterdam, N. Y.*—An electric railway is projected to run to Hagaman's Mills.

Jersey City, N. J.—The Jersey City & Bergen Ry. Co. has been granted power to operate its cars by electricity. Storage batteries will be used if they can surmount the steep grades; otherwise an overhead wire system will be used.

East Orange, N. J.—The East Orange Rapid Transit Co. has been organized, and proposes to adopt storage battery cars. President, JAMES E. REYNOLDS; Secretary, H. S. FERMAN.

Johnstown, Pa.—The Johnstown Street Ry. Co. ha leased its lines to Mr. T. L. JOHNSON, of Cleveland, O., who will put in an electric plant.

Greensburg, Pa.—The Greensburg & Hempfield Electric Street Ry. Co. has been incorporated to build a line 4 miles long. The incorporators are R. S. JAMISON, GEO. M. JONES, W. A. HUFF, E. DONAHUE, and J. B. HEAD. Capital stock, $60,000.

Memphis, Tenn.—The Citizens' Street Ry. Co., of which Mr. C. B. HOLMES is President, contemplates operating its line by electricity.

Macon, Ga.—The Thomson-Houston Electric Co. has the contract for the entire equipment of the electric road, and will have it in operation within 12 months.

Racine, Wis.—The Belle City Street Ry. Co. will probably adopt an electric system. Mr. CHARLES HATHAWAY of Cleveland, O., is President.

Milwaukee, Wis.—Mr. HINSEY has awarded the contract for the construction and equipment of his electric road to the Thomson-Houston Electric Co.

Denver, Col.—The Denver Tramway Co. will build 2 electric roads, aggregating 15 miles, on the Thomson-Houston system.

Seattle, W. T.—Mr. NEVINS is making the surveys for the electric road from Union Lake to Green Lake. The contract for grading has been let to G. E. Boman.

Cable Railways.—*Chicago, Ill.*—The West Chicago Street Ry. Co. has been granted a franchise for a line on Taylor St. The company must build a pier and abutments for a bridge over the river.

Portland, Ore.—The Portland Cable Ry. Co. has awarded the contract for the construction of the 5th St. line to the Pacific Cable Construction Co., of San Francisco. It will be a double-track road and will be equipped with 5 cars. The driving plant will be manufactured at Cleveland, O., and will be operated by two Corliss engines of 700 H. P., with cylinders 24 x 48 ins. The contract for block paving has been let to the Portland Paving & Macadamizing Co.

Spokane Falls, W. T.—The cable railway has been completed and opened for traffic.

Seattle, W. T.—The Madison Street Cable Ry. Co. has awarded the contract for the construction of 2 miles of double track to the Pacific Cable Construction Co., of San Francisco. The cost is estimated at about $300,000, or $500,000 including rolling stock, etc.

Elevated Railway.—*Brooklyn, N. Y.*—The Brooklyn Elevated Ry. Co. will probably extend its road along Fulton Ave. to Cypress Ave. as soon as the necessary consent of property owners is obtained.

HIGHWAYS.

Kansas City, Mo.—The following proposals for five miles of macadamized roads have been received by F. J. O'FLAHERTY, County Surveyor: Andrew Quicks, Chicago, $1.17; C. Yetter, Independence, Mo., $1.19; R. E. Ela, Wyandotte, Kan., $1.33; M. Holmes & Son, Kansas City, $1.42½; G. E. Evans, Kansas City, $1.44¾; L. H. McAller & Co., Kansas City, $1.45; G. H. Burke, Kansas City, $1.49; Wheeler & Dean, Kansas City, $1.69; John Dwyer, Kansas City, $1.85.

Colorado Roads.—The sum of $16,000 is to be expended on a new wagon road to Rico, whereby the cost of hauling ore from Rico to the railroad will be reduced from $12 per ton, the present price, to $8. The importance of such an improvement is apparent from the fact that the reduction in the cost of transporting ore will be so great. Probably it will not be long before a railroad is built into Rico; but even if the railroad should be built within twelve months after the completion of the new wagon road, the money expended upon the road would not be thrown away. It is not well that a town should be dependent upon a railroad company; and a good wagon road is a good regulator of a railway, even though it may be little used. The State has not enough good wagon roads. By the expenditure of a moderate amount of money excellent roads could be built, and the time will come when the wisdom of making them will be recognized.—*Denver Republican.*

New Jersey Roads.—Messrs. B. M & J. F. Shanley, the contractors, have begun the improvement of St. George's Avenue as contemplated by the County Road law and under the contract awarded to them recently by the Board of Chosen Freeholders, of Union County. The avenue will be graded and paved with telford, from the city line of Elizabeth into the city of Rahway. The work will be proceeded with as rapidly as possible, and the improvements will be finished this fall. Michael Mahon, the contractor for the road to Springfield, has a force at work on the Morris Turnpike at the Hummock, and another gang at the Springfield end of the route. ——The Union County Board of Freeholders, at Elizabeth, has sold the $150,000 county road bonds; GEORGE E. BENNETT, a New York broker, taking $135,000 at a premium of 24-100 of one per cent. The bonds are of the denomination of $1,000 each and bear 4 per cent. interest. ——At the last session of the Legislature an act was passed to enable the overseers of roads in certain road districts to call meetings for the purpose of raising money for the use of roads.

La Crosse, Wis.—About 250 men are employed on the wagon road across the Minnesota bottoms to connect with the Mississippi River Bridge.

CONTRACTING.

Street Work.—*Seattle, W. T.*—Contracts have been awarded as follows: J. O. Martin, 28 and 33 cts. for earthwork, $17.50 for cribbing, sidewalks and bridging, $17 for box draws. Alden & Morf, 30 cts. for earthwork, $18 for cribbing, $16.50 for sidewalks, $17 for box drains, $100 for grubbing.

Berkeley, Cal.—The following proposals have been received by the Trustees: W. J. Schmidt, grading per cu. yd., 59 cts.; nothing for fill; culverts, per lin. ft., 60 cts. John Brennen, grading, 40 cts.; nothing for fill; culverts, 50 cts. College way: J. J. Dunn, grading and macadamizing, 7¼ cts. per sq. ft.; patent gutters, 8¾ cts. per sq. ft.; curbing, 12½ cts. per lin. ft.

Dredging.—*Salem, Mass.*—The committee on North River has awarded the contract for dredging to Thomas Symonds, for $6,100. The contract specifies that 5,000 cu. yds. are to be dredged in the canal above the bridge, and 20,000 cu. yds. below the bridge. CHARLES A. PUTNAM will superintend the work.

Buildings.—The Kings County Supervisors, Brooklyn, N. Y., have awarded the contract for the erection of 4 brick buildings, 3 brick and stone stables, and 3 stone icehouses at the St. Johnland county farm to John H. O'Rourke at his bid of $627,000. There were five bids submitted and O'Rourke's was the lowest. The buildings are for the accommodation of the insane.

Jail.—The contract for the reconstruction of Hall County Jail, Gainesville, Ga., has been awarded to the Champion Iron Fence Co., of Kenton, O., by the commissioners of roads and revenues, for the sum of $4,125. The company is to place 6 steel cells.

Sewers.—*Providence, R. I.*—Contracts have been awarded as follows: In Grove and Knight Sts.; Frederick E. Shaw: $1.55 and $1.60 per ft. for 18 and 20-in. circular brick, $1.10 and $1.15 for 12 and 15-in. pipe, 70 cts. for 8-in. pipe connections to basins, $1, 10 cts. and 10 cts. each, for 12, 8 and 6-in. connections, $20 for catch basins and manholes, $12 for extra inlets. In Broadway

and Tobey Sts.: F. E. Shaw; $2.20 per ft. for 24 x 36 ins. and 20 x 30 ins. brick, $2 for 18-in. brick, $1.20 for 12-in. pipe, 60 cts. for 8-in. pipe connections to basins, $1 and 10 cts. each for 12-in. and 8-in. connections, $10 for basins, $15 for manholes, $12 for extra inlets. In Mallett St.: F. E. Shaw: 90 cts. per ft. for 12-in. pipe, 10 cts. each for 6-in. connections, $18 for manholes. In Grove St.: F. E. Shaw: $1.20 and 60 cts. for 12 and 8-in. pipe; $10 for basins and inlets, $5 for manholes. In Ring St., F. E. Shaw, same prices, $7 for manholes, $12 for inlets. In Abny and Gesler Sts.; F. E. Shaw, 60 cts., $1.20 and $1.25 for 8, 12, and 15-in. pipe, 10 and 15 cts. for 6 and 8-in. connections, $5 for basins, $10 for manholes, $12 for inlets. In Congdon St.: John Keogh: 50 cts. and $1.25 per ft. for 8 and 12-in. pipe, 20 cts. each for 6-in. connections, $5 each for basins, $12 for inlets. In Ring St.: John Keogh: $1.10 for 12-in. pipe, 10 cts. each for 6-in. connections, $16 for manholes.

Sewers.—*Bath Beach, L. I.*—The following proposals for sewers were received Oct. 5 by S. H. McELROY of Brooklyn, N. Y., Engineer to the Sewer Commissioners:

East Division.

Contractor.	Piles.	Y. Pine.	Spruce.	Concrete	24-inch cement pipe.	18-inch cement pipe.	15-inch cement pipe.	12-inch cement pipe.	Manholes.	Totals.
	$	$	$	$	$	$	$	$	$	$
J. Morrissey	5.00	45	30	6.50	4.20	2.00	1.50	1.00	43	49,396.50
J. Curran & Co.	4.50	35	25	6.00	2.61	2.50	1.60	0.90	42	49,762.30
J. McNamee	3.00	50	25	5.00	2.60	2.00	1.50	1.15	30	49,767.00
Thos. McCann	6.00	60	25	5.00	4.65	2.00	1.75	1.15	30	54,337.75
E. E. Eglee	4.00	50	25	5.00	3.00	2.30	1.75	1.35	40	57,901.25
Everson & Liddle	5.00	47	35	6.00	4.00	3.50	2.20	1.75	44	75,397.10
Quantities	100	10 M.	70 M.	100 yds.	350 ft.	3,270 ft.	13,813 ft.	14,850 ft.	40	

West Division.

Contractor.	Piles.	Y. Pine.	Spruce.	Concrete	24-inch cement pipe.	18-inch cement pipe.	15-inch cement pipe.	12-inch cement pipe.	Manholes.	Totals.
	$	$	$	$	$	$	$	$	$	$
J. McNamee	5.00	50	35	5	2.60	2 00	1.60	1.00	30	39,382.00
J. Curran & Co	4.50	35	25	6	2.61	2 50	1.60	0.90	42	39,476.50
E. E Egiee	4.00	50	25	5	3.25	2.25	1.65	1.25	40	43,276.00
T. S. Jenkins	5.00	45	25	5	4.50	2.90	1.60	1.00	45	43,926.40
Thos. McCann	6.00	60	25	5	4.65	2.00	1.75	1.15	30	44,124.50
Quantities	400	10 M.	60 M.	100 yds.	950 ft.	3,166 ft.	8,500 ft.	10,800 ft.	36	

Berkeley, Cal.—The following proposals have been received by the trustees: Bristol St.; Ed. Cavanaugh; sewer, 40 cts.; Y's, 60 cts.; manholes, $45; lampholes, $6. W. J. Schmidt; sewer, 69 cts.; Y's, 69 cts.; manholes, $50; lampholes, $7. M. Heffey; sewer, 53 cts.; Y's, 69 cts.; manholes, $45; lampholes, $7. Channing Way: Ed. Cavanaugh; sewer, 43 cts.; Y's 60 cts.; lampholes, $6. W. J. Schmidt, sewer, 75 cts.; Y's, 60 cts.; lampholes, $7. P. Begly; sewer, 45 cts.; Y's, 45 cts.; lampholes, 45 cts. M. Heffey; sewer, 58 cts.; Y's, 60 cts.; lampholes, $9.

St. Paul, Minn.—Proposals will be received Oct. 15 for the construction of sewerage systems for, Union and Merriam Parks. The sizes will be 9, 12, and 15-in. diameter, and the work will include flushtanks. We received notice of this work last week, too late for publication, and would remind engineers and municipal authorities that notes of work to be carried out should be sent as early as possible. L. W. RUNDLETT is City Engineer. GEO. L. WILSON is Assistant City Engineer and Superintendent of Sewers.

Grading. — The following proposals for filling in and grading low lands, etc., at Fort Hamilton, New York Harbor, have been received by Lieut. A. W. VOGDES, U. S. A.: John McGlyn, Fort Hamilton, $8,797; F. McNally & Patrick McNaughton, Fort Hamilton, $9,949; Henry Martin, Fort Hamilton, $9,995; Thomas R. McCann, 431 8th St., Brooklyn, $10,000; Theodore S. Jenkins, Gravesend, $11,697; Chas A. Cregin, 44 Broadway, New York, $16,400. The contract was awarded to John McGlyn.

Tunnel. — The following bids have been received by the Town Clerk, Ashland, Pa., for the construction of a tunnel, open channel and culvert. All the bidders were local firms. Theo. D. Wever, $4,650.90; J. Gibbs & D. Lewis, $4,805.35; P. Troutman, $4,825.87; W. J. Ryan, $4,998.55; J. C. O'Neil, $5,191.80; J. B. Caulfield, $5,322.65; C. Kiehl & Co., $5,470.27; J. Colahan, $5,497.40; Geo. B. Kiehl & Co., $5,781.59; Douglas & Co., $6,900.20; Engelbert Schmuecker, $6,996.65; Owen Colahan, $8,514.75. The contract was awarded to J. Gibbs & D. Lewis.

Cement. — The following proposals for furnishing 500 bbls. of quick or slow-setting Portland cement have been received by the Docks Commissioners, New York City: Haebler & Co., $2.32½ per bbl.; Emil Lentz, $2.33; James Brand, $2.35; E. W. Fisher, $2.42½; Francis G. Brown, $2.45; Marcial & Co., $2.50; Lincoln & Babson, $2.60. The contract was awarded to Haebler & Co.

PROPOSALS OPEN.

Sewers. — Section 1 of the Brighton intercepting sewer, Sections 8 and 9 of the South Boston intercepting sewer. Earth excavation and refilling, brick, concrete, and stone masonry, 10-in. drain pipe, etc. WM. JACKSON, City Engineer, Boston, Mass. Oct. 15.

Pumping Station. — Engine house, boiler house and smoke stack. A. H. MCALPINE, Superintendent and Engineer of Water-Works, Columbus, O. Oct. 15.

Street Work. — Belgian block paving and bluestone curb. JOHN P. ADAMS, Commissioner of City Works, Brooklyn, N. Y. Oct. 15.

Water Supply and Sewerage.—For Fort Russell Wyo. Capt. CHAS. F. HUMPHREYS, Depot Quartermaster's Office, Cheyenne, Wyo. Oct. 16.

Dock Work.—Dock, breakwater and sea-wall on Swinburne Island, and concrete, asphalt, and other work on Hoffman Island, and certain repairs at the Boarding Station, Staten Island. Separate bids for each kind of work are to be made. Plans and specifications may be seen at the office of Mr. STEPHEN D. HATCH, Architect in Charge, 115 Broadway. CHAS. F. ALLEN, President, Quarantine Commissioners 71 Broadway, New York City. Oct. 16.

Pier Work and Dredging.— Repairing Pier 55, and bulkheads, near the foot of Grand St., East River, and dredging thereat. THE DOCKS COMMISSIONERS, Pier A, North River, New York City. Oct. 18.

Water-Works Bonds.—Sale of $15,000 bonds. JULIUS FRIESEKE, Mayor, Owosso, Mich. Oct. 21.

Dredging.— Dredging the Raleigh plains, about 7½ miles. Engineer R. MCDONELL, Chatham, Ont. J. G. STEWART, Clerk of the Municipal Council, Raleigh, Ont., Canada. Oct. 21.

Jail.— County jail and jailer's residence. WM. L. MOORE, County Auditor, Martinsville, Ind. Oct. 21.

Creosoting.—Creosoting about 15,000 cu. ft. of yellow pine lumber for the U. S. S. *Terror* at the Brooklyn navy yard. The Government to furnish the lumber, and the cost of transportation to be borne by the contractor. JAMES FULTON, Paymaster General, U. S. N., Navy Department, Washington, D. C. Oct. 21.

Bonds.—Granite pavement fund bonds for $125,000 and additional granite pavement fund bonds for $150,000. EDWIN STEVENS, Comptroller, Cincinnati, O. Oct. 21.

Street Lighting.—By gas or electricity. THOMAS P. SHAW, Chairman of Committee on Street Lamps, Portland, Me. Oct. 21.

Dock.—Repairing government dock at Fort Wayne. Lieut. LEA FEBIGER, U. S. A., Fort Wayne, Mich. Oct. 21.

Roof.—Repairing roof of State Arsenal at 7th Ave. and 35th St. Gen. J. M. VARIAN, Chief of Ordnance, 7th Ave. and 35th St., New York City. Oct. 22.

Bridges.—Three wooden bridges. W. G. SMITH, County Clerk, Macon, Ga. Oct. 23.

Culvert.—Semicircular arch culvert. THE COUNTY COMMISSIONERS, Cincinnati, O. Oct. 26.

Water-Works Bonds.—For $25,000 7 per cent. bonds. J. W. LIEUALLEN, Town Clerk, Moscow, Idaho. Oct. 28.

Bridge.—Iron bridge over the Kansas River. Bids for bridge complete, including earthwork, or excepting earthwork, or for earthwork approach alone. FRANK MAPES, County Clerk, Kansas City, Kan. Oct. 28.

Bonds.—City improvement bonds. H. E. BRYAN, City Clerk, Columbus, O. Oct. 30.

Water-Works Bonds.—For $24,000. WM. TURNER, Secretary of the Board of Water Commissioners, Rouse's Point, N. Y. Nov. 1.

Removing Rock.—Bids will be received on behalf of the Kootenai Valleys Co. (Ltd.), of London, England, for the widening of the Kootenai Lake outlet, near Nelson, B. C., by the removal of loose rock and boulders above low-water mark by means of traveling derrick (approximately 18,750 cu. yds.). Plans and specifications, with further particulars respecting tenders, can be seen at the office of the company's engineer at Kootenai Lake, B. C. (via N. P. R. R.). Personal inspection is essential. Bids to be addressed to C. W. BUSK, Assoc. M. Inst. C. E., care Bank of British Columbia, Victoria, B. C. Nov. 15.

MANUFACTURING AND TECHNICAL.

Market Prices. — *Rails.* — New York and the East prices have an upward tendency, and some Eastern mills are asking $31 and $32. Pittsburg: $33 to $34. Chicago: $33 for standard sections and $36 for $35 to 40 lb. sections.——During the week large orders, aggregating 160,000 tons, have been given out by Western roads, about 115,000 tons of which were given to Chicago mills.

Track Material. —New York: spikes, $2.10 to $2.15 delivered; angle bars, 1.95 to 2 cts.; track bolts, 2.9 to 3 cts. for square and 3 to 3.25 cts. for hexagon. Pittsburg: spikes, 2.10 cts., 30 days, f. o. b.; splice bars, 1.85 to 1.90 cts.; frack bolts, 2.75 to 2.8 cts., with square and 2.9 to 3 cts. with hexagon nuts.

Structural Iron. — Chicago: prices for beams and channels have been advanced ⅛ cts. per lb. Western prices are now as follows: Chicago and Milwaukee, 3.30 cts.; Wisconsin, except Milwaukee, and towns on Mississippi not north of Iowa, 3.25 cts.; towns on Mississippi north of Iowa, 3.30 cts.; towns in Missouri off of the Mississippi River and on the Missouri River not above Sioux City, 3.50 cts. Prices for tees have also been advanced. Prices for mill lots of shapes are as follows, f. o. b. angles, 2.25 cts. to 2.35 cts.; universal plates, 2.40 cts.; sheared plates, 2.45 cts. to 2.50 cts.; tees, 2.75 cts. to 2.85 cts.; beams and channels, 3.20 cts. Small lots from store; 2.40 cts. to 2.50 cts. for angles, 2.80 cts. to 3 cts. for tees and 3.70 cts. for beams and channels.

Locomotives. — The Baldwin Locomotive Works, of Philadelphia, Pa., have delivered 6 engines to the Baltimore & Ohio for fast freight service.

The Brooks Locomotive Works, of Dunkirk, N. Y., will build 10 mogul freight engines and 5 switching engines for the Big-Four road.

The Chesapeake & Ohio road has received four ten-wheel engines, built to the designs of Mr. Garstang, Superintendent of Motive Power.

The Union Pacific has ordered 15 consolidation engines, with cylinders 22 x 28 ins.; 22 ten-wheel engines for passenger and fast freight service; 62 in. drivers, 5 with cylinders 19 x 24 ins. and 17 with cylinders 20 x 24 ins. 10 six-wheel switch engines with cylinders 18 x 26 ins. The consolidation engines will be built by the Cooke Locomotive Works, of Paterson, N. J., and the others by the New York Locomotive Works, of Rome, N. Y.

Cars.—The Gilbert Car Works, of Troy, N. Y., have an order for 200 freight cars for a South American road.

The Terre Haute Car Works, of Terre Haute, Ind., have an order for 100 stock cars for the Big-Four road. They will be equipped with air brakes and the Janney coupler.

The U. S. Rolling Stock Co. has a large order for cars for the San Antonio & Aransas Pass road.

The Indianapolis Car Works, of Indianapolis, Ind., have an order for 300 coal cars for the Lake Shore & Michigan Southern, and 500 box cars for the Missouri, Kansas & Texas.

The Ohio Falls Car Co, of Jeffersonville, Ind., is building 250 cars for the East Tennessee, Virginia & Georgia and 750 for the Louisville & Nashville. They expect to build 6 passenger cars for the Fort Wayne, Cincinnati & Louisville.

The Mobile & Ohio road is building at its works at Whistler, Ala., 100 box cars, 100 fruit cars, 50 gondolas and 50 stock cars.

The Northern Pacific road has given out orders for 3,000 freight cars.

Gas Motors.—The Connelly Mfg. Co. has been incorporated in Union County, N. J., with a capital stock of $100,000. It will construct gas engines for street railway purposes, and several buildings for the purpose will at once be erected in Elizabeth. The principal stockholders are CHARLES W. BLODGETT, CHARLES L. ROWLAND, and W. J. LOGAN, of New York; JOHN S. CONNELLY, of Plainfield, THOMAS E. CONNELLY, of Cranford, and the Connelly Motor Co., of Newark.

Iron Works.—The Lancaster Iron Co. has been incorporated at Pittsburg, Pa. LLOYD BOOTH, President; JAMES W. FRIEND, Vice President; FRED MOTHERAL, Secretary; RALPH J. WICK, Treasurer and General Manager. JAMES W. FRIEND and GEORGE HOFFSTADT, of Pittsburg; LLOYD BOOTH and RALPH J. WICK, of Youngstown, O.; DAN. DANEHY, GEORGE J. ATKINS, and GERHARD MILLER, of Lancaster, O., directors. The company will immediately remove its large rolling and bar mills from West Middlesex, Pa., to Lancaster, O., also the foundry and machine shops of J. W. Russell, from Hubbard, O., and West Middlesex, Pa.

The Gutter-Sweeping Machine Co. has been organized at San Francisco, Cal., by LOUIS METZGER, A. EVERETT BALL, E. A. NEWLAND, J. R. FRITZ, and S. F. MCDILL. Capital stock, $100,000.

The Syracuse Granite Co. has been incorporated at Albany, N. Y., by J. H. TOLMAN, WILLIAM VAN AUKEN, and MICHAEL SULLIVAN. The capital stock is placed at $50,000. The company owns and will work the granite quarries on Grindstone Island, St. Lawrence River.

Cement.—The Buckeye Portland Cement Co., of Bellefontaine, O., has had tests made of the hardness of its cement. It is said that while it required 100 minutes to cut 5-16 in. off a block of Buckeye Portland cement, 1 in.

square, held on a grindstone run 333 ft. per minute, and with a weight of 26 lbs., it required but 2 2-5 minutes to cut the same quantity off a similar sized block of Berea paving stone.

Steamer.— The Jonson Foundry & Machine Co., of New York, launched on Sept. 28 the iron steamer tender *Argus*, built at the company's yards for the U. S. Government. The steamer is 85 ft. long, 15 ft. 9 ins. beam, 9 ft. deep, and has a displacement of 92 tons. It is said to be the first iron vessel built within the corporate limits of the city of New York.

Nut Locks.—The National Nut Lock Washer Co., of Newark, N. J., has an order for about 1,000,000 nut locks for an English railway.

The Troy Malleable Iron Co., of Troy, N. Y., has leased the plant of the Capital City Malleable Iron Co., at Albany.

Steel Castings.— The Massey Co., of Toronto, will manufacture steel castings under the patents of J. F. Bott, of London, England.

The Alameda Contracting Co. has been organized by A. BANNISTER, GEO. L. LEWIS and T. A. SMITH, of Alameda, Cal., and LEANDER SAWYER and W. W. WHITE, of Oakland. Capital stock, $30,000. The company has been organized for the purpose of constructing, paving and macadamizing streets and roadways, and for constructing sewers and for carrying on a general contracting business.

The Employers' Liability Assurance Corporation, Boston, reports that Mr. J. A. CRAWFORD, of Quincy, Ill., who died by accident suddenly, a short time ago, had recently drawn an accident ticket for $500 from one of the automatic ticket boxes now so frequently seen at railway stations and elsewhere. The ticket cost only 5 cts. but insured the payment of $500 by the company.

The Ball Engine Co., of Erie, Pa., reports shipments of 20 engines during September. They were for street railway and electric light companies, mills, etc. One engine was sent to Germany and one to the Thomson-Houston International Electric Co., of Iquique, Chili.

The Christy Fire Clay Co., of St. Louis, has completed some extensive buildings and kilns at its works on the Gravois & Morgan Ford road. The buildings are of brick, and are equipped with the latest improved hoisting and heating machinery. Several large dry and wet pans and pug mills have been added to the plant, together with one of Fritz's improved 80 H. P. engines. This company has now a drying floor with a capacity for 300,000 fire brick every 24 hours. An improved steam hoist has also been erected at the company's mines. These improvements, together with the new branch railway, double the capacity of the works.

Railway Material Wanted. — New standard gauge equipment to replace narrow gauge. S. PACKARD, Receiver, Texas Western Ry., Houston, Tex.

About 750 tons of 40-lb. steel rails; spikes and splice bars; delivered at Portsmouth, Va. A. F. PAGE, Aberdeen, N. C.

About 2 miles of light rails, second hand. J. H. LAWSON, Talladega, Ala.

Meters.—The National Meter Co.'s business has steadily increased from the beginning to its present large extent. The company states that the fact of its selling 40,000 water meters in 51 months, and its total sales now 70,000, in number, indicates that the managers of waterworks of the United States and Canada, appreciate the value of water meters.

Road Machines.—The American Road Machine Co., of Kennett Square, Pa., issues an illustrated pamphlet describing its different forms of road machines, wheel scrapers, grading and breaking plows, etc., for town and county roads. The company has a number of testimonials as to the merits of these machines.

BRIDGES AND CANALS.

New York State Canals and Bridges.—The following contracts have been awarded by JAMES SHANAHAN, Superintendent of Public Works, Albany, N. Y.:

Liberty St. bridge, Schenectady, appropriation $5,000. Awarded to W. H. Shepard & Sons, Havana, at $352.50. The other biddders were: Rochester Bridge & Iron Works, $3,625.60; King Bridge Co., Cleveland, $3,878.46; Berlin Iron Bridge Co., Binghamton, $3,881.68; Hilton Bridge Co., Albany, $4,024.18.

Wall at Whitehall; appropriation $30,000. Awarded to Jeremiah Adams, Whitehall, at $15,736.50. Other bidders: J. W. Whalen, Whitehall, $18,375; Monty & Parker, Sandy Hill, $18,801.25; Flood & Riley, Sandy Hill, $19,726; Troy Public Works Co., $22,475.25; J. F. Finch, Glens Falls, $21,741.50; J. E. Flood & Co., Sandy Hill, $18,594.75.

George St. bridge, Rome, the appropriation of $5,000 was not sufficient. The lowest bidders were the Rochester Bridge & Iron Works, $2,988 for superstructure, and Thomas Lane, Syracuse, $3,841.50 for the substructure.

Removal of obstructions in Oswego River; appropriation $5,000. Awarded to P. J. Brummelkamp, Syracuse, at $4,853.75. No other bidder.

Wall at Schenectady, $78,500 appropriated. Awarded to Casey, Murray & Co., Elmira, at $13,580,36. Other bidders, G. V. Rapp, Canajoharie, $16,289,86; P. J. Brummelkamp, $15,867; Hughes Bros., Syracuse, $15,791; Monty & Parker, $16,899.40; Flood & Riley, $15,560.40; Troy Public Works Co., $17,865.

Repairing Glens Falls feeder; appropriation $30,000. Awarded to D. Sturtevant, Sandy Hill, at $3,154. Other bidders: Monty & Parker, $4,156; Flood & Riley, $3,512.50; Troy Public Works Co., $3,887; James E. Flood & Co., $3,633; Clark & Casey, Fort Edward, $4,424.40.

Wall at Utica; appropriation $3,000. Awarded to William Fuller, Rochester, at $2,391. Other bidders: P. J. Brummelkamp, $3,610, John H. Nelson, Herkimer, $2,767.

Changing machinery on Clyde and Brockport lift bridges; appropriations $1,500 and $2,650,70. Awarded to W. H. Shepard & Son, Clyde at $1,373.80, and Brockport at $2,021.30.

Repairing dyke at Null's light. Awarded to Wm. Fuller & Sons, Albany, at $1,038.30. Other bidder, L. A. Marshall, $1,144.80. Repairing dyke at Castleton Light, to Wm. Fuller & Sons at $1,016. Repairing dyke opposite New Baltimore, to Wm. Fuller & Sons at $3,623.93.

Fultonville bridge at Main St.; appropriation $8,000 for superstructure. Rochester Bridge & Iron Works, $5,280; King Iron Bridge Co., $5,625; Berlin Iron Bridge Co., $5,475; Groton Bridge Co., informal. Bids for building the substructure will have to be readvertised for.

The awarding of the contracts for dredging 9,000 cu. yds. at Coeymans and at the nine-mile tree, Castleton, were withheld for the present.

The contract for rebuilding Lock No. 8 on the Cayuga & Seneca Canal was awarded to A. C. Martin, of Seneca Falls, at $12,937.50. The other bidders were: Emmett & Morrison, Waterloo, $16,487.50, and McGreevy, Murray & Co., Elmira, $14,417.50.

There was but a single bid for the work of placing machinery in Locks 9 and 10, Oswego Canal, and the contract was not awarded.

Bridge Notes.—*Grand Isle, Vt.*—The town has voted $3,000, in addition to the $10,000 voted last March, towards the cost of a bridge to North Hero.

Manchester, N. H.—The contract for raising the abutments and rebuilding the Deer Neck bridge, at Lake Massabesic, has been awarded to Henry K. Tilton & Co.

Portland, Pa.—The first train passed over the Delaware River Bridge of the Pennsylvania, Poughkeepsie, & Boston Ry. on Oct. 1. The bridge is of iron, 1,600 ft. long and 70 ft. high.

Pittsburg, Pa.—The South 22d. St. Bridge Co. has been organized by JOHN F. STEEL, A. M. KEEFER, and ROBERT FRASER, to build a bridge over the Monongahela. Capital stock, $30,000.

McKeesport, Pa.—The McKeesport & North Side Bridge Co., has been incorporated by H. L. DELONG, W. L. BRISBIN, A. A. HARWOOD, J. SCHRADER, and P. P. GAME. Capital stock, $10,000.——The Duquesne Bridge Co. will soon begin work.

Richmond, Va.—The Mayo Bridge & Improvement Co. has been organized to build a bridge connecting with Manchester. President, WARE B. GAY, of Boston, Secretary, J. T. BROWN, of Richmond. Capital stock, $50,000.

Chattanooga, Tenn.—The county bridge bonds have been sold to Forster, Leech & Co., of Chicago, at 104.

Nashville, Tenn.—The City Engineer has prepared plans for a $60,000 bridge over the railways at Demonbreun St.

Covington, Ky.—The Council has passed the ordinance granting the Chesapeake & Ohio Ry. Co. the right to build an iron bridge over the railroad tracks at 15th St. The ordinance provides that the bridge shall be 175 ft. long and 37 ft. wide, having 22 ft. for wagonways and 7½ ft. for foot-ways. The railroad is to depress its track to give 20 ft. clear between the floor of the bridge and the tracks. The road is to indemnify property owners who are injured, and is to make graded approaches of not more than ten ft. in the hundred.

Decatur, Ala.—The railway has been ordered by the city to build bridges over its tracks at three streets.

Zanesville, O.—The contract for the superstructure of the Brush Creek Bridge has been awarded to the Smith Bridge Co., of Toledo, O., at $10,000.

Appleton, Wis.—The contract for an iron canal bridge has been let to the Wisconsin Bridge & Iron Co., at $5,300.

La Crosse, Wis.—The War Department, at Washington has approved the plans for the Mississippi bridge.

Watertown, Wis.—It is proposed to build a bridge over the Rock River, 5 miles south of the town.

Rapidan, Minn.—The County Commissioners have let a contract for a bridge over the Blue Earth River, to cost $2,665.

Weeping Water, Neb.—An iron bridge is to be built at a cost of $1,500.

St. Charles, Mo.—The City Engineer has presented estimates for a bridge at 6th St.

St. Louis, Mo.—The contract for the steel superstructure of the approaches of the Merchants' Bridge, about 1,600,000 lbs., has been awarded to the Union Bridge Co., which has the contract for the bridge superstructure.

Kansas City, Mo.—F. J. O'FLAHERTY, County Surveyor, has awarded a contract for an iron truss bridge to the Wrought Iron Bridge Co., of Canton, O., at $700.

Colfax, W. T.—The County Commissioners have awarded the contract for an iron bridge at South Main St. to the Pacific Bridge Co., at $9,750.

Laredo, Tex.—The contract for the Chacon St. Bridge has been awarded to the Kansas City Bridge Co., at $11,900.

Ottawa, Canada.—It is proposed to make the bridge to Hull, which is now under construction, 40 ft. wide instead of 30 ft., putting the sidewalks outside the trusses.

Viaduct.—*Indianapolis, Ind.*—The Union Railway Co. is expected to advertise very soon for proposals for the construction of the bridge over its tracks at South Meriden St. WM. R. MCKEEN, President of the Terre Haute & Indianapolis Ry. Co., is President of the Union Ry. Co.

ELECTRICAL.

Electric Lighting.—*Exeter, N. H.*—The Board of Trade has requested the Thomson-Houston Electric Co. to make a proposition for putting in an electric light and power plant.

Springfield, Mass.—The United Electric Light Co. has increased its capital from $150,000 to $250,000. Secretary, A. J. FENNESSY.

Warsaw, N. Y.—A contract has been made with the Westinghouse Electric Light Co. for 25 arc lights at $65 per light.

Tonawanda, N. Y.—An electric light company has been organized.

Brooklyn, N. Y.—The Brooklyn Electric Light & Power Co. has been granted a franchise, after 18 months delay.

Bloomfield, N. J.—A contract has been made with the Edison Electric Light Co. for 500 lights of 25 c. p. at $7,500.

Murfreesboro, Tenn.—An electric plant for street lighting is being put in by Osbin, Smith & Talley.

Savannah, Ga.—The proposition for the city to own and operate an electric light plant of its own is being favorably considered.

Milledgeville, Ga.—The Brush Electric Co. will put in a plant for street lighting. The Milledgeville Oil & Fertilizer Co. will furnish the power.

Tampa, Fla. — The Heisler Electric Light Co., of St. Louis, Mo., will put in an incandescent plant.

Ravenna, O. — The Ravenna Gas Co. has offered to sell its electric plant to the city for $13,000. The City Council will pay $10,718, claiming that was the cost of same to the company, and if not accepted, will secure a Westinghouse plant set up complete for $10,621.

Van Wert, O.—A contract has been made with the Citizens Electric Light & Power Co.

Effingham, Ill. —The Council has decided to contract for a plant of 25 arc lights of 2,000 c. p. each.

Kaukauna, Wis. — The Kaukanna Electric Light Co has been incorperated by W. H. EARLES, CHAS. KIRCHOFF, Jr., and HENRY JUNGE. Capital stock, $30,000.

De Pere, Wis. — The De Pere Land & Water Power Co. will put in an electric light plant.

La Crosse, Wis.—Propositions to establish electric light plants have been received from the Jenney Electric Co., of Indianapolis, the Thomson-Houston Electric Co., of Boston, and the Brush Electric Co., of La Crosse.

Ouray, Col.—The Ouray Electric Light & Power Co. has been organized and has acquired the present plant which will be extended. President, F. WALSEN; Manager, D. C. HARTWELL.

Rico, Col.—An electric light company has been organized by D. SUICKHEMER and GEO. S. BARLOW, of Rico; H. P. and C. W. CORBIN, of Telluride; and H. R. WOODALL, of Philadelphia. Capital stock $15,000.

Tucumseh, Neb.—A vote will be taken Oct. 15, on a proposition to issue $9,400 for electric lights and a court house.

Los Angeles, Cal.—The Thomson-Houston Electric Co., through S. H. TAYLOR, its agent at San Francisco, has made a proposition to put in an arc and incandescent light plant and a power plant.

The Heisler Electric Light Co., of St. Louis, Mo., has been awarded a gold medal for its exhibit at the Paris Exposition.

SEWERAGE AND MUNICIPAL.

Street Work.—*Fultonville, N. Y.*—Main St. is to be macadamized.

Buffalo, N. Y.—Contracts have been awarded as follows: Asphalt paving on Court St., Prospect Ave. and Mohawk St., Barber Asphalt Co., $19,132, $49,696 and $12,685. Stone paving on Rhode Island St., C. E. Williams, $5,284; on Hydraulic St., and Georgia St., Boland & Conners, $5,200 and $6,700; on Babcock St., P. B. McNaughton, $30,800.

Newark, N. J.—Asphalt paving is being laid on Broad St.; it is laid on a concrete foundation and compressed by a 7-ton steam roller.

Washington, D. C.—Property owners on 7th St., between Pennsylvania Ave. and Boundary St. want the granite block pavement replaced with asphalt.—The cost of the street work proposed by the Commissioners is as follows: county, $204,450; Georgetown, $65,000; northwest, $247,000; southwest, $78,000; southeast, $130,000; northeast, $130,000; total, $854,450.

Lincoln, Neb.—The city is spending $400,000 on brick street paving.

Toronto, Ont.—Contracts for street work have been awarded by the Board of Public Works to A. W. Godson, H. A. Brown, Richard West, Burns & McCormack, and Van Vlack.

Macon, Ga.—An act has been signed by the governor, authorizing the city to issue $200,000 in bonds for street improvement and sewerage.

Sewers.— ***Milford, N. H.***— The first section of the sewerage system has been completed at a cost of $7,750.

Salem, Mass.—Appropriations will be made for $11,000 for a sewer on Webb St., and $650 for catch basins on Webster St.

Carthage, N. Y.— The city has voted to issue $20,000 for sewers.

Lansingburg, N. Y.—Gray & Temple have the contract for two lateral sewers.

Syracuse, N. Y.— An 18-in. tile sewer is to be built in South Salina St., and a 24-in. brick sewer in Shonard St.

Kinston, N. C.—The town has voted to issue bonds for $4,000 for sewers and other improvements.

Way Cross, Ga.—An act has been passed authorizing the establishment of a system of sewerage.

Winona, Minn.—The specifications for the Shone system of sewerage have been sent to City Engineer FELLOWS by Engineer BROUGHTON, of Chicago.

Denver, Col.—A comprehensive scheme for a complete system of sewerage has been drafted by Col. IRVING.

Kearney, Neb.—A vote will be taken in November on a proposition to issue $70,000 in bonds for a sewerage system. Mr. Cox, C. E., has made a report recommending the separate system, for sewage only. The total cost is estimated at $127,676.25, of which $51,489.25 is for mains, and the balance for laterals in the six districts.

Ogden, Utah.—The City Engineer has presented a report on a sewerage system and a special committee has been appointed to consider the matter.

San Rafael, Cal.—The sewerage system is complete, but an outfall system is necessary, as the sewage now discharged into the creek does not all flow out to San Francisco Bay, but fouls the channel and is saturating the marshes. Mr. GEO. M. DODGE, C. E., has presented a report on this matter and recommends the building of an outfall sewer, with an iron discharge pipe across the marshes through which the sewage would be pumped. The cost is estimated at $25,000, and the operating expenses at $200 per month.

Houston, Tex.—The contract for the sewerage system has been awarded to Isaac Heffron.

Palestine, Tex.—The City Council has appointed a committee to investigate and report upon a system of sewerage.

WATER-WORKS.

NEW ENGLAND.

Northwood, N. H.—Engineer G. W. LANE has finished the survey for laying a main from Jenness pond to the Narrows.

Reading, Mass.—H. G. KITTREDGE, Editor of the Boston *Journal of Commerce*, has kindly sent us the following information:

The town has voted to accept the act of the last State Legislature granting to the town the right of introducing a water supply system. According to the requirement of the act, three commissioners will be chosen in November. Money will probably also be appropriated for preliminary surveys, etc. The cost of the proposed works will be about $100,000.

[Any further information may be obtained by addressing Mr. H. G. KITTREDGE, of Reading.—ED.]

North Adams, Mass. — Samples of water from the wells furnishing the city's supply have been analyzed by the State Chemist, and condemned as unfit for use, being contaminated with sewage and surface water.

Paxton, Mass.—Sealed proposals will be received by the Water Commissioners of the Leicester Water Supply District on Oct. 12, for furnishing materials and performing all work connected with the laying of about 4,000 ft. of mains. Address the Water Commissioners, or F. L. FULLER, Engineer, 12 Pearl St., Boston.

Ware, Mass.—The Water Commissioners are replacing the 1-in., by 4 and 6-in. pipes on South St.

Athol, Mass.—Work is progressing slowly at the Lake Ellis dam, though the essential part of the work will probably be completed this fall. There is a project on foot to dredge a channel between Lakes Ellis and Ellenwood, deep enough to give passage to a small steamer.

Litchfield, Conn. — We have received the following information from T. H. MCKENZIE:

Surveys are in progress for a gravity system of works to cost about $50,000. The supply will be taken from Griswold brook, 4½ miles from the town. Contracts will all be let between Oct. 15 and 20, to be completed, June 1, 1890. The officers of the Litchfield Water Co. are: President, F. H. WIGGINS; Treasurer, C. B BISHOP. Consulting Engineer, J. J. R. CROES, of New York. Engineer in charge of surveys, T. H. MCKENZIE. Population about 2,000.

Windsor Locks, Conn.—The water company is now ready to receive applications and make connection for water for domestic, manufacturing, and other purposes. The dam and pump house are completed.

MIDDLE.

Poughkeepsie, N. Y.—The estimated cost of maintaining and improving the works for 1890 is $22,700. Of this amount, specifications from improvements are made as follows: Filter beds, new sand, cleaning, $1,860; distribution system, repairs, and supplies, $4,000; meters, $2,500.

Troy, N. Y.—A small amount of new mains have been ordered laid.—The Fitchburg R. R. Co., has presented a petition asking for a 4-in. lateral to connect with the stand-pipe north of Middleburg Street to furnish water for locomotives.

Albany, N. Y.—A committee of thirteen has presented a communication favoring the construction of a larger filtering plant for purifying Hudson river water, and continuing to take the city's supply from this source instead of the driven wells or Patroon creek source; making such additions to the pumping capacity, and the present system, generally, as the demand may require —A report has also been made by the Special Water Commission showing the progress of work, and expenses incurred to date.

Brooklyn, N. Y.—A resolution has been offered in the City Council calling for 100 hydrants for the Twenty-sixth ward.

Sing Sing, N. Y.—The Board of Water Commissioners has sold $30,000 of 4 per cent bonds to Daniel H. Moran & Co., at $113.85.

Rahway, N. J.—The city will probably soon issue new bonds.

Woodstown, N. J.—We have received the following from W. D. CLAYTON:

A number of citizens have been considering the question of establishing complete works, taking the supply from springs two miles from town.

Roger's Ford and Spring City, Pa.—R. E. SPRINGER has sent us the following:

The Home Water Co., of Roger's Ford, with a subscribed capital stock of $30,000 to $50,000, has awarded the contract for complete works. Work was commenced in September, and will be completed about Dec. 1. Water will be pumped from artesian wells to a stand-pipe. The officers are: President, J. A. BUCKWALTER; Secretary, U. S. G. FINKBINER. Engineer, ISAAC S. CASSIN, of Philadelphia.

Philadelphia, Pa.—An ordinance authorizing the Mayor to enter into contracts for the purification of the water supply has been brought up and referred to the Committee on Works. Director WAGNER is reported as saying, "the Mayor's plan is to build subsiding reservoirs, but that as there is only $10,000 available to the Water Department the most that can be done is to do away with the Kensington supply station and build a 1,000,000-gall. reservoir at Roxborough to supply adequately the extreme Northwestern section of the city.' The storage capacity of the city's reservoirs have already been increased five fold.—The East Park reservoir has been completed and put into service.

Pittsburg, Pa.—Bids were received on Oct. 10, for constructing an influent chamber at the Bedford pumping station.

Paoli & Berwyn, Pa.—The Dayleford Water Co. has been chartered, and the following officers elected: President, WILLIAM LATTA; Vice-President, WILLIAM HAMMERSLEY; Secretary, W. M. GRAHAM.

Annville, Pa—Z. S. G. LIGHT informs us that two charters have been granted. C. DEAN is Secretary of one company, and H. ZIMMERMAN of the other.

Frostburg, Md.—The reservoir is being enlarged.

Cumberland, Md.—It is reported that additional mains, and better service, generally, are needed.

SOUTHERN.

Roanoke, Va.—New mains are to be laid, and other improvements made. All information can be obtained from HOWARD MURPHY, of Philadelphia, Pa., Consulting Engineer of the new works.

Wheeling, W. Va. — The new reservoir upon being filled was found to leak badly, and the city has decided to employ an expert engineer to examine and report upon it before accepting it from the contractor.

Rutherfordton, N. C.— Prices of material, etc., are wanted by C. BURNETT, Mayor.

Spring Hill, N. C.— It is reported that works are needed, and that a company will be formed to construct them.

Hartland, N. C.— A 1,000,000-gall. reservoir has recently been constructed. Water is to be conveyed to the Bee Mountain gold mine by erecting new sluiceways.

Anderson, S. C.— The City Council is arranging to build a system of works. Address the Mayor.

Union, S. C.— Works are projected. Address the Mayor.

Augusta, Ga.—It is reported that the Anglo-American Water & Gas Co. is negotiating to purchase the gas and water-works.

Marion, Ala.—W. H. Barrett & Son, have the contract for putting in the works in the Marion Military Intute. Work is progressing rapidly.

Fort Payne, Ala.—Nier & Mitchell, of Kansas City, Mo., inform us that works have been built in this place under their direction, and are now in operation.

Florence, Ala.—The Cypress Water-Works have been purchased by Jeter & Boardman, of Macon, Ga., contractors for the new works. They have taken charge, and will furnish the city with water through them until the new system is completed. The excavations for the foundation of the stand-pipe of the new plant have been made. The tank is to be 30 ft. high by 40 ft. in diameter, having a capacity of 3,000,000 galls. It will be placed on a stone tower 90 ft. high. The tower will be double-walled, with a spiral staircase in the center, and an observatory enclosed by an iron railing on top.

Biloxi, Miss.—The large artesian well for the water company has been completed. Water was struck at a depth of 870 ft. The flow is 250 galls. per minute.

Greenville, Miss.—Work is to be commenced on the new works at once. J. A. Jones is the contractor. Four satisfactory wells have already been sunk.

Durant, Miss.—H. F. LAWRENCE is reported as saying that the I. C. R. R. has recently completed a small system of works. The water is pumped from 10 3-in. wells, 40 ft. deep, by a Worthington pump of 300 galls. capacity per minute.

Union City, Tenn.—The following information is from P. J. EVANS, Recorder:

Bids for constructing works are now being received. Contracts will be let about Oct. 15. Water will probably be pumped from wells to a stand-pipe. Population 5,000.

North Knoxville, Tenn.—ROBERT IRVIN, Recorder, informs us that the citizens expect next Spring to perfect some plan for a water supply separate from the city of Knoxville, from which the present supply is obtained.

Columbia, Tenn.—The works have been purchased by the Columbia Improvement Co.

Mayfield, Ky. — John T. Foley, of Nashville, Tenn., has contracted with the Commonwealth Construction Co., of Philadelphia, Pa., for laying new mains.

Hickman, Ky. — W. S. MCCUTCHEON, City Clerk, has sent us the following:

The City Council has appointed a committee to investigate the question of constructing works, and report: GEO. WARNER is Chairman of the Committee. Estimated cost, $2,500 to $4,000. The proposed source of supply is from the river.

Paris, Ky.—Works costing from $30,000 to $50,000 are to be constructed. Address the Paris Water Co.

Shelbyville, Ky.—Surveys for the new works will soon be made. Address T. J. RAMSEY.

Louisville, Ky. — CHAS. R. LONG, President, in his annual report, states that it will soon be necessary to expend $250,000 in improving the company's plant.

The improvements will include laying a 48-in. main from Crescent Hill reservoir to some suitable point of distribution in the city, and changing many of the smaller mains to larger sizes. Also to improve the quality of the supply by establishing a large filtering plant. Money for the above improvements to be met either out of the earnings or net revenue of the company, or by issuing more bonds under a second mortgage.

NORTH CENTRAL.

Upper Sandusky, O.—The Upper Sandusky Water-Works Co. has been incorporated at Columbus. Capital stock, $60,000.

Cleveland, O.—Since the air-pressure machine was put in operation, no further trouble with quicksand has been experienced, and the tunnel has been built forward 30 ft. The workmen have now reached solid clay. The men digging toward the shore have reached a point 1,394 ft. south of the water-works crib. It is now believed that the tunnel will be completed on or before Sept. 15, 1890.—Applications have been made to the trustees for laying 4 or 5 miles of additional mains.

Marietta, O.—The letting of contracts has been declared off owing to legal difficulties. Bids will again be advertised for, and contracts let about Oct. 30. JOHN W. HILL, of Cincinnati, O., is Consulting Engineer.

Hammond, Ind.—A supply main from Lake Michigan has been projected. It would be 5 miles in length.

Crawfordsville, Ind.—A mortgage for $250,000 has been filed in favor of the American Loan & Trust Co., of New York. It is given by the Water Supply Co., of Crawfordsville, and the money is to be used to buy the works, as soon as the affairs of the latter corporation can be adjusted.

Seymour, Ind.—The mains are being extended.

Big Rapids, Mich.—The contract for laying a new main across the Muskegon River, has been let to Clough, Peirce & Co.

Owosso, Mich.— Sealed bids will be received until Oct. 21, for the sale of $15,000 of bonds. For particulars address JULIUS FRIESEKE, Mayor.

Eaton Rapids, Mich.—A petition has been presented to the City Council in favor of bonding the city for $40,000 to build works.

Manistee, Mich.—The company contemplates laying 2 or 3 miles of additional mains.

Lansing, Mich.—It is reported that the pumps will be lowered next spring, 2 miles of 6-in. mains laid, and 2 6-in. artesian wells will be drilled.

Huntington, Ind.—The date of receiving proposals for a complete system is indefinitely postponed.

Ishpeming, Mich.—The city is changing the source of its supply from Lake Angeline to Lake Sally, at an expense of $35,000, and will probably spend as much more in a short time for new pumps and buildings.

La Grange, Ill.—La Grange Light & Water Co., has been incorporated to furnish water and electric light for public and private uses. Capital stock, $125,000. The incorporators are: SAMUEL A. MOFFATT, J. L. HOTCHKIN and R. B. HOTCHKIN.

Peoria, Ill.— The company has presented papers stating that they have completed their search for water, and are ready now to finally accept the terms offered by the ordinance, from the city. Also that they are ready to pay the bonds now due, held by the city, and have executed a bond of $200,000, with good and sufficient sureties, conditioned for the faithful performance of the contract. A recent analysis of the water they propose furnishing, showed it to be of excellent quality.

Aledo, Ill.— S. D. C. HAYS, informs us that works costing about $22,000 have been constructed by the U. S. Wind Engine & Pump Co., of Batavia Ill., since July 1. Water is pumped from an artesian well, 3,113 ft., deep to a tank of 1,800 bbs. capacity, by a Cook artesian well pump.

Somonauk, Ill.—Works will probably be constructed. Address the City Clerk.

Edwardsville, Ill.— Works are projected.

Washington Heights, Ill.— The following is from C. A. FRANK:

An artesian well is now being sunk. Mains will be laid in the streets. The works will be built and owned by the town.

Kilbowen City, Wis.—The proposition to raise $5,000 for the construction of works was carried at the special election on Oct. 3. The plant will be located at the east end of Broadway.

Superior, Wis.—It is reported that works are to be established.

Manitowoc, Wis.—Woodbury, Moulton & Stearns, of Springfield, Mass., have purchased, and are now offering for sale, $135,000 of first mortgage, 6 per cent. twenty years bonds.

Milwaukee, Wis.—The ordinance authorizing the issue of $500,000 of bonds for the construction of a new intake pipe, has been recommended for passage by the Council Committee on Finance. The issue of such bonds was authorized by the Legislature several years ago, but they could not be issued before the expert engineers submitted their report. City Engineer BENZENBERG intends to proceed with the work immediately after the bonds are issued. The tunnel will be built from the present water-works to a distance 2,000 ft. into the lake. At the end of the tunnel a crib will be erected; from the crib, pipes will be extended still further into the lake to a point where the water is from 50 to 60 ft. deep. The tunnel will have to be conducted at a depth of about 100 ft. under the bottom of the lake. At that distance a solid stratum of clay has been struck which will make the subterranean work much easier.——The Committee on Water-Works authorized the laying of pipes on Madison, Grove and Lapham Sts., and on Fifth Ave', betweeen Virginia and Clinton Sts.

NORTHWESTERN.

Waterloo, Ia.—The works have been sold to a company composed of the bondholders, for $83,000. President, J. S. QUIGLEY, of St. Louis.

Guthrie Center, Ia.—The question of building works is being discussed.

West Duluth, Minn.—The City Council has passed an ordinance repealing the ordinance passed Jan. 7, granting a franchise to the West Duluth Light & Water Co. to construct works.

New Ulm, Minn.—Contractors are looking over the ground, and will soon submit bids for constructing works.

Mankato, Minn.—At the special election held to vote on the question of issuing $40,000 of bonds for the extension of the works, a majority vote of about 200 was cast. Address E. LILLY, City Engineer.

Madelia, Minn.—Works are to be constructed. Address the City Clerk.

Windom, Minn.—Works are projected.

Duluth, Minn.—A communication recently presented to the City Council from the City Attorney, stated that the Gas & Water Co. had been, and is now, giving poor service. It urged procuring written statements from water consumers regarding failures on the part of the company to fulfil its contract, with dates and all necessary particulars, in order that the city might have something in which to base a suit against the company for the forfeiture of its franchise.

Osage City, Kan.—It is reported that works are to be constructed.

Argentine, Kan.— The works being constructed by the Argentine Water & Electric Light Co. will be put in operation about Jan. 1, 1890. JOHN W. NIER, of Kansas City, Mo., is the Engineer.

Omaha, Neb.—The company has begun laying a 16-in. pipe along Commercial St.

Pierre, Dak.—Work is progressing rapidly.

Watertown, Dak.—Extensions are to be made. Address the City Clerk, H. L. SHELDON.

Fort Scully, Dak.—Bids will soon be wanted for constructing works.

Fort D. A. Russell, Wyo.— Bids for constructing a sewerage system and complete works will be received by CHARLES F. HUMPHREY, Captain and A. Q. M., U. S. A., on Oct. 16.

SOUTHWESTERN.

Webb City and Carterville, Mo.—JOHN W. NIER, of Kansas City, Mo., informs us that plans for complete works for both places have just been completed, and that contracts will be let and work begun as soon as financial arrangements can be completed. Address the Engineers, Nier, Hartford & Mitchell, Kansas City, Mo., for information.

Kansas City, Mo.—The city is about to bring legal action against the company for non-fulfilment of its contract.

Aberdeen, Tex.—Works will probably be constructed.

Houston, Tex.—It is reported that the company is not furnishing a sufficient pressure for fire protection.

Bryan, Tex.—We have received the following from T. N. CAREY:

Contracts for works, costing from $25,000 to $28,000 will be let within 60 days by the Bryan Water, Ice & Electric Light Co. Water will be pumped from wells to a standpipe. President, J. N. HENDERSON; Secretary, A. D. McCONINCO; Engineer, L. F. FULLER. Population, 3,000.

Berthoud, Col.—The company has sold its plant to the town for $12,000.

Denver, Col.—RICHARD HOLME, Secretary and Manager of the Citizen's Water Co., sends us the following information:

The Citizens' Water Co. has been incorporated to establish a separate system of gravity works, work on which was begun in September. The high-service system, on the 36-in. line of pipe, is to be put in operation about July 1, 1890, and the low-service system, on a 48-in. line of pipe, about Jan. 1, 1891. The supply is to be taken from the South Platte river. Three reservoirs with a capacity of 5,000,000,000 galls. are to be constructed in the mountains, and two, with capacities of 20,000,000 and 10,000,000 galls. respectively, in the city. Eighty miles of cast-iron pipe will be laid. Estimated daily consumption, 1,200,000 galls. Pressure: ordinary, 75 lbs.; fire, 125 lbs. Estimated cost, $2,000,000. Capital stock, $3,000,000. President, DAVID H. MOFFATT; Secretary and Manager, RICHARD HOLME. Designing Engineer, CHAS. P. ALLEN; Consulting Engineer, E. S. NETTLETON.

New Castle, Col. — Complete works will probaby be constructed.

PACIFIC.

Colville, Wash.—The Colville Water & Light Co. has been incorporated at Olympia. Capital stock, $50,000. The trustees are: H. W. MASON, IRA JONES, and E. D. MINER. Their object is to supply towns in Stevens County with pure water.

North Spokane, Wash.—The North Spokane Water-Works Co. has been incorporated. Capital stock, $200,000. The Trustees are: P. S. BYRNE and F. D. STANLEY. Their purpose is to construct, maintain, and operate water-works, and to purchase, take possession of, use and hold land and water for the purpose of supplying the lands in and adjacent to the city of Spokane Falls, and in Spokane County.

Fairhaven, Wash. — Works are to be constructed by the Fairhaven Water Co. Estimated cost, $150,000. The supply will probably be taken from Lake Padden. J. J. DONAVAN is the Engineer.

Salem, Ore. — Divers from Portland are now at work examining the supply pipe, and it is reported that the city's supply will soon pass through the new filter from the middle of the river.

Enterprise, Ore.—Articles of incorporation have been filed with the Secretary of State for the Enterprise Water Co. Capital stock, $5,000. The incorporators are: J. M. CHURCH, R. F. STUBBLEFIELD, and W. H. CHOLLISS.

San Francisco, Cal.—The petition of the Point Lobos Improvement Society for the extension of the company's mains has been acted upon favorably by the Water Committee ——Another proposition has been submitted to the Committee on Water and Water Supplies to furnish the city with water, by THOMAS J. CLUNIE for the El Dorado Water & Deep Gravel Mining Co.

San Bernardino, Cal.—The Board of City Trustees has issued a call for an election to vote upon the question of issuing $160,000 of bonds, with which to provide the city with a water system for fire protection.

Lakeport, Cal.— The citizens have voted in favor of issuing $15,000 of bonds for works.

Santa Cruz, Cal.—The Santa Cruz Water Co. has filed articles of incorporation. The company has a capitalization of $500,000, divided into 5,000 shares of $100 each. The directors are: CHARLES B. LUDWIG, C. H. JACKSON, of New York; FREDERICK R. KING, E. H. RIXFORD, and C. K. BONESTELL, of San Francisco. The contract for supplying pipe for the new works has been awarded to the Risdon Iron Works.

San Diego, Cal.— The San Diego Land & Water Improvement Co. will probably issue $1,000,000 of bonds for improvements.——Engineer J. D. SCHUYLER estimates that it will cost $382,444 to lay sufficient pipe to supply 100,000 people.

Anaheim, Cal.—The city will probably issue $600,000 of bonds for water improvements.

Ogden City, Utah.—The Bothwell bond for the sum of $150,000, for the faithful construction of the city works has been signed by J. R. BOTHWELL, President, and J. H. BACON, Secretary, for the Bear Lake & River Water-Works Irrigation Co., and approved by the City Council.

CANADA.

South London, Ont.—City Engineer TRACY'S recent recommendatiog for increasing and improving London's supply, provides for 40 hydrants in this place.

Sarnia, Ont.—The town has voted $3,000 for improvements and extensions.

Chatham, Ont.—The Town Council has advertised for tenders for furnishing a supply of water for public use. The proposed source of supply is from a bored well.

Windsor, Ont.—Kerr & Co., of Walkerville, Ont., have been awarded the contract for furnishing pumping engines of 3,000,000 galls. daily capacity

Winnipeg, Man.—A plan for the proposed water-power works has been submitted to the City Council, by City Engineer RUTTAN, and adopted.

ARTESIAN WELLS.

Monte Vista, Colo.—It is reported probable that 500 wells will be sunk in the San Luis valley within the next year. One hundred wells have already been sunk.

Elk Point, Dak.—The well is down 500 ft.

El Paso, Tex.—The city has appropriated $25,000 for sinking wells. Bids are wanted by the Mayor.

Live Oak, Fla.—A well is needed. Address the Town Clerk.

Dakota.—Sixteen wells are to be put down in Beadle County for private parties. Contracts have been made.

Fort McPherson, Ga.—Bids will be received until Oct. 14 for sinking a well at this place, by J. W. JACOBS, Capt. and A. Q. M., U. S. A., Atlanta, Ga.

Portland, Oregon.—A well being put down for the Portland hotel has reached a depth of 100 ft.

Heppner, Oregon.—The City Council has appropriated $1,500 for a 500 ft. well.

Kaukauna, Wis.—A well recently sunk, 816 ft. deep, flows 360,000 galls. per day.

Farmington, Wash.—A well is being sunk.

IRRIGATION.

Greeley, Col.— The OLIVER party sent out to make surveys near the head-waters of the Grand River to ascertain if the river's waters could be made to flow in an easterly direction and thus utilized for irrigating, have returned, and reported the project not feasible.

California.—A contract for digging the first 7 miles of the Central Canal for the irrigation districts of Colusa County has been awarded to the San Francisco Bridge Co., at $213,000.——Turlock Irrigation District has sold $700,000 of bonds.——A scheme is projected to dam the stream which supplies the Bridal Veil falls in the Yosemite valley, and use the water for irrigation.

Washington.—The plans for irrigating Yakima valley have been completed, and the work on canals and ditches will be begun soon.

Colorado Springs, Colo.—The Hagerman Irrigation & Land Co. has been incorporated by J. I. HAGERMAN, H. C. LOWE and C. B. EDDY. Operations will consist in taking water from the Pecos river in the southern part of New Mexico, Eddy County. The capital stock is $300,000 [This probably refers to the "Pecos Irrigation Co." mentioned in our issue of Sept. 28; the trade name having been changed.—ED.]

Las Vegas, N. M.—The trust deed of the Valverde Land & Irrigation Co., has been filed with the County Clerk. President, WILSON WADDINGHAM. Estimated cost of work, $2,000,000.

Las Cureces, N. M.—The Jornado & El Paso Canal & Reservoir Co. has been formed to construct works.

Fresno, Cal.—Legal action has been brought against the Fresno Canal & Irrigating Co., by the Fresno Milling Co., to prevent that company from appropriating certain water rights.

Sacramento, Cal.—Articles of incorporation of the Feather River Canal Co., has been filed with the County Clerk. The company is to construct and maintain canals, ditches, etc., and to collect, conduct and distribute water for irrigation and other purposes.

Kansas City, Mo.—A corp of engineers is taking soundings in the bed of the Missouri River for the Missouri River and Land Improvement and Construction Co. preparatory to beginning the work of erecting dykes for the reclamation of land on the levee fronting this city. A number of pile-driving machines have been provided and as soon as the engineers have completed their work a large force of men will be put to work.

Salem, Ore.—Articles of incorporation of the Hurricane Water Ditch Co., of Wallowa County, have been filed with the Secretary of State. The incorporators are: PETER O. SULLIVAN, H. LEGO, P. A. WRIGHT, J. B. SCHAFER, RUSSEL BUSION, M. ENZELHOUR, W. U. CROW, JONATHAN HAAS and G. S. REAVIS. Capital stock, $900, Place of business at the house of J. B. SHAFER, in Joseph precinct.

ANNUAL REPORTS.

Receipt of the following reports is acknowledged:

Vermont.—St. Johnsbury; from CHAS. CALDERWOOD, ex-Superintendent.

Connecticut.—New London; W. H. RICHARDS, Engineer and Superintendent.